

# RS431/ RS432 Precision Programmable Reference

## 1 FEATURES

- **Reference Voltage Tolerance at 25°C**  
0.5% (A Grade)  
1% (B Grade)
- **Programmable Output Voltage to 36 V**
- **Low Dynamic Output Impedance 0.2 Ω**
- **Sink Current Capability of 0.5mA to 100mA**
- **Equivalent Full-Range Temperature Coefficient of 50ppm/°C Typical**
- **Temperature Compensated for Operation Over Full Rated Operating Temperature Range**
- **Low Output Noise Voltage**
- **Fast Turn on Response**
- **Operation Junction Temperature from -40°C to 150°C**
- **Lead-Free Packages: SOT23**

## 2 APPLICATIONS

- **Adjustable Voltage and Current Referencing**
- **Power Supply**
- **Zener Replacement**
- **Voltage Monitoring**
- **Comparator with Integrated Reference**
- **As Precision Voltage Reference**

## 3 DESCRIPTIONS

The RS431 and RS432 device are three-terminal adjustable shunt regulators, with a guaranteed thermal stability over applicable temperature ranges. The output voltage can be set to any value between  $V_{REF}$  (approximately 2.5V) and 36V with two external resistors. These devices have provided a very sharp turn-on characteristic, making these devices excellent replacement for Zener diodes in many applications.

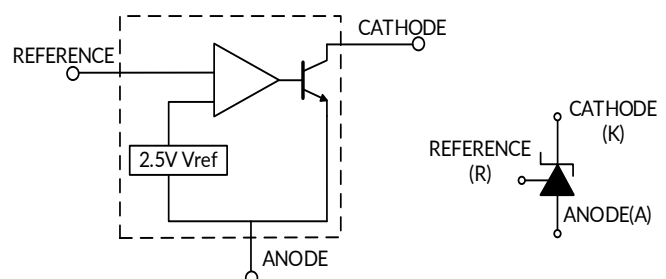
Both the RS431 and RS432 devices are offered in two grades, with initial tolerances (at 25°C) of 0.5% and 1%, for A and B grade.

### Device Information <sup>(1)</sup>

PART NUMBER	PACKAGE(PIN)	BODY SIZE (NOM)
RS431	SOT23(3)	1.30mm×2.92mm
RS432	SOT23(3)	1.30mm×2.92mm

(1) For more detail information packages, see the order sheet.

## 4 Function Block Diagram



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## 5 Revision History

Note: Page numbers for previous revisions may differ from page numbers in the current version.

Version	Change Date	Change Item
A.1	2018/11/03	Initial version completed
A.2	2020/03/25	(1) Change part-number to ordering information table for production management. (2) Added Figure 8 Reference Voltage vs. Ambient Temperature
A.3	2021/10/28	(1) Update parameters in Electrical Characteristics on Page 5@A.2 Version (2) Update parameters in Typical Performance Characteristics on Page 7, 8@A.2 Version
A.4	2022/07/01	Update PACKAGE MARKING on Page 4@RevA.3
A.5	2023/05/11	Add RS431AYSF3-C and RS432AYSF3-C ORDERING NUMBER on Page 4@RevA.4
A.6	2024/01/22	Added MSL on Page 4@RevA.5

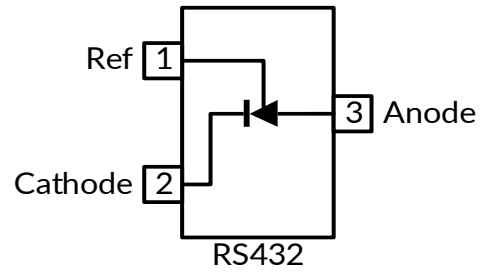
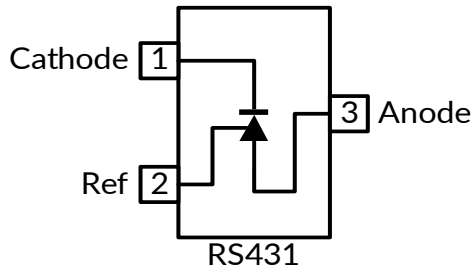
**6 PACKAGE/ORDERING INFORMATION <sup>(1)</sup>**

PRODUCT	ORDERING NUMBER	VOLTAGE TOLERANCE	PACKAGE LEAD	PACKAGE MARKING <sup>(2)</sup>	MSL <sup>(3)</sup>	PACKAGE OPTION
RS431	RS431AYSF3	0.5%	SOT23	431A XXXXX	MSL3	Tape and Reel,3000
	RS431AYSF3-C	0.5%	SOT23	431A XXXXX	MSL3	Tape and Reel,3000
	RS431BYSF3	1%	SOT23	431B XXXXX	MSL3	Tape and Reel,3000
RS432	RS432AYSF3	0.5%	SOT23	432A XXXXX	MSL3	Tape and Reel,3000
	RS432AYSF3-C	0.5%	SOT23	432A XXXXX	MSL3	Tape and Reel,3000
	RS432BYSF3	1%	SOT23	432B XXXXX	MSL3	Tape and Reel,3000

**NOTE:**

- (1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.
- (2) Package marking:  
Line1: Product model  
Line2: Internal code(1-bit) + date code (3-bit) +1-bit LOT code
- (3) MSL, The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications.

## 7 Pin configuration and Functions (Top View)



### Pin Description

NAME	PIN		DESCRIPTION
	RS431	RS432	
Cathode	1	2	Shunt Current/ Voltage input
Ref	2	1	Threshold relative to common anode
Anode	3	3	Common pin, normally connected to ground

## 8 SPECIFICATIONS

### 8.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) <sup>(1)(2)</sup>

Characteristics		Symbol	MIN	MAX	UNIT
Cathode Voltage		$V_{KA}$	-0.3	37	V
Cathode Current Range (Continuous)		$I_{KA}$	-100	+155	mA
Reference Input Current Range		$I_{REF}$	-0.05	+10	mA
Operating junction temperature		$T_{opr}$	-40	+150	°C
Package thermal impedance <sup>(3)</sup>	SOT23	$\theta_{JA}$		295	°C/W
Power Dissipation		$P_D$	370		mW
Storage temperature		$T_{stg}$	-55	150	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) All voltages are with respect to the GND pin.

(3) The package thermal impedance is calculated in accordance with JESD-51.

### 8.2 ESD Ratings

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-Body Model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>	±4000	V
		Charge Device Model (CDM), per ANSI/ESDA/JEDEC JS-002 <sup>(2)</sup>	±1000	V
		Machine Model (MM)	±200	V

(1) JEDEC document JEP155 states that 500 V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250 V CDM allows safe manufacturing with a standard ESD control process.



### ESD SENSITIVITY CAUTION

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 8.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

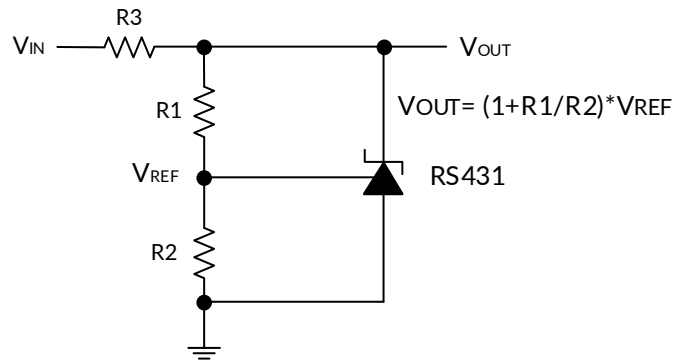
Characteristics		Symbol	MIN	MAX	UNIT
Cathode Voltage		$V_{KA}$	$V_{REF}$	36	V
Cathode Current Range (Continuous)		$I_{KA}$	0.5	100	mA
Operating Ambient Temperature Range		$T_A$	-40	+125	°C

## 8.4 Electrical Characteristics

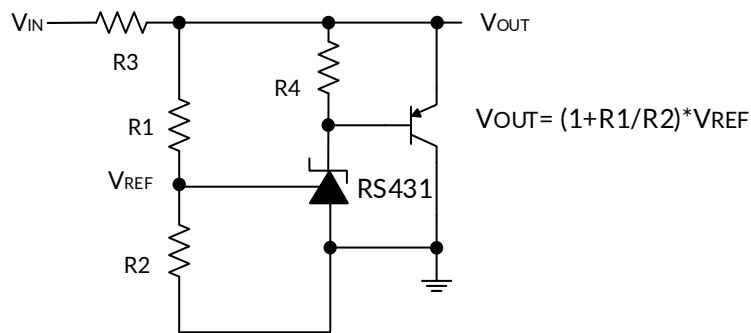
(Over recommended operating conditions, Full= -40°C to +125°C, typical values are at T<sub>A</sub>= +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	
Reference Input Voltage	V <sub>REF</sub>	V <sub>KA</sub> =V <sub>REF</sub> , I <sub>KA</sub> =10mA	0.5%	2.488	2.50	2.512	V
			1%	2.475	2.50	2.525	V
Deviation of reference Input Voltage Over temperature	ΔV <sub>REF</sub>	V <sub>KA</sub> =V <sub>REF</sub> , I <sub>KA</sub> =10mA T <sub>A</sub> = -40°C ~ +125°C	-	20	60	mV	
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	ΔV <sub>REF</sub> /ΔV <sub>KA</sub>	I <sub>KA</sub> =10mA	ΔV <sub>KA</sub> =10V~V <sub>REF</sub>	-	-1.2	-2.0	mV/V
			ΔV <sub>KA</sub> =36V~10V	-	-1.5	-2.0	
Reference Input Current	I <sub>REF</sub>	I <sub>KA</sub> =10mA, R1=10kΩ, R2=∞	-	1.7	4.0	uA	
Deviation of Reference Input Current Over Full Temperature Range	ΔI <sub>REF</sub>	I <sub>KA</sub> =10mA, R1=10kΩ, R2=∞ T <sub>A</sub> = -40°C ~ +125°C	-	2	5	uA	
Minimum cathode current for regulation	I <sub>KA</sub> (min)	V <sub>KA</sub> =V <sub>REF</sub>	-	0.3	0.5	mA	
Off-state Cathode Current	I <sub>KA</sub> (OFF)	V <sub>KA</sub> =36V, V <sub>REF</sub> =0V	-	0.05	0.5	uA	
Dynamic Impedance	Z <sub>KA</sub>	V <sub>KA</sub> =V <sub>REF</sub> , I <sub>KA</sub> =1mA to 100mA f≤1.0KHz	-	0.2	0.5	Ω	

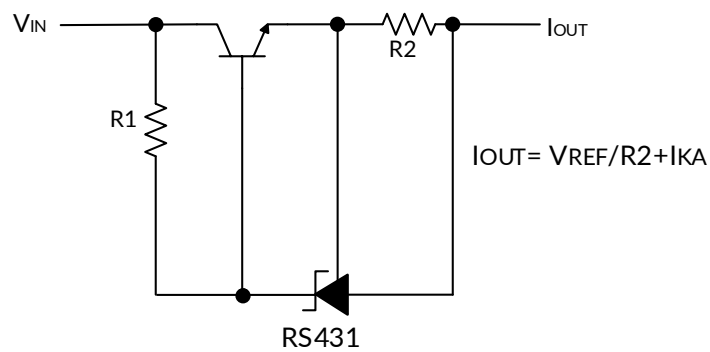
### 8.5 TYPICAL APPLICATIONS CIRCUIT



**Figure 1. Shunt Regulator**



**Figure 2. High Current Shunt Regulator**



**Figure 3. Current Source or Current Limit**



## 8.6 TYPICAL PERFORMANCE CHARACTERISTICS

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

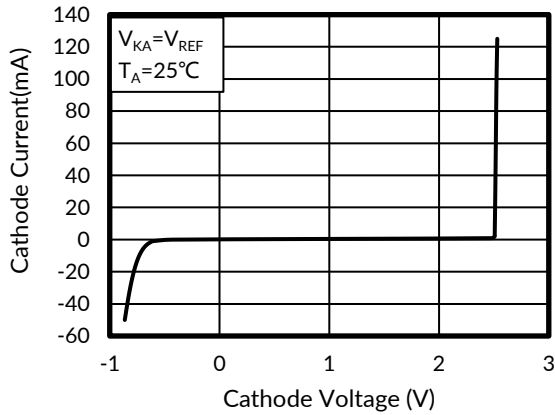


Figure 4. Cathode Current vs Cathode Voltage

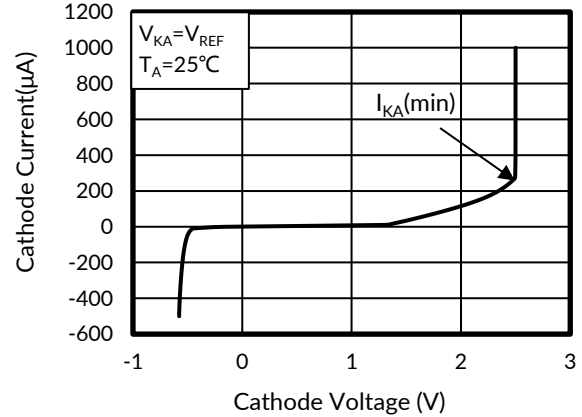


Figure 5. Cathode Current vs Cathode Voltage

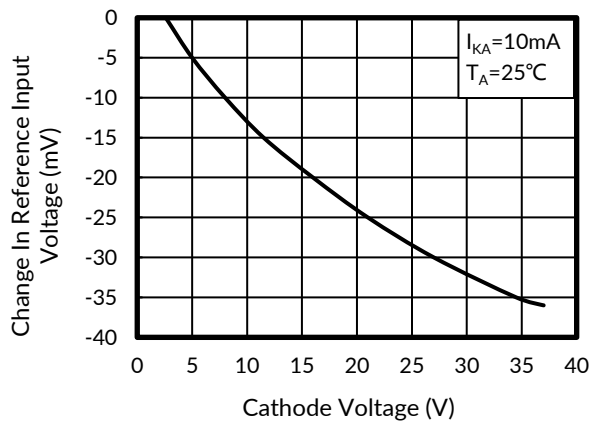


Figure 6. Change in Reference Input Voltage vs Cathode voltage

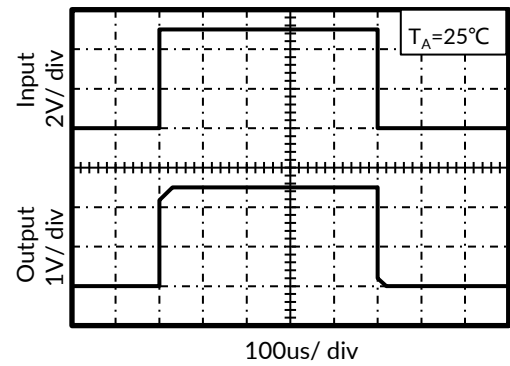


Figure 7. Pulse Response

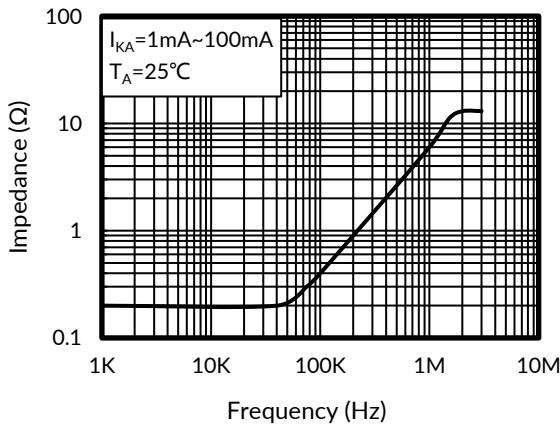


Figure 8. Dynamic Impedance vs Frequency

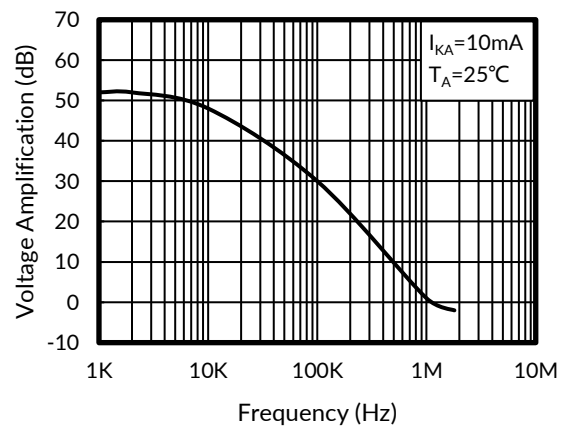
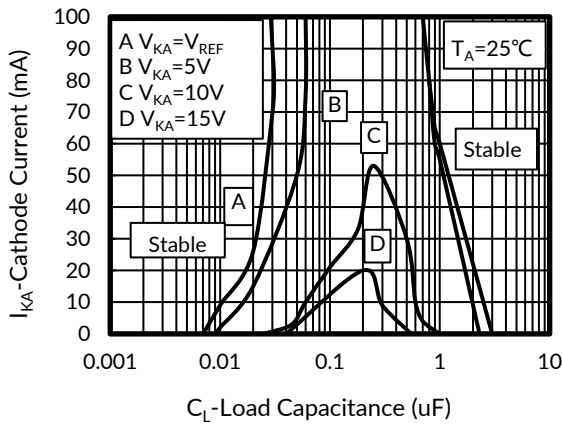


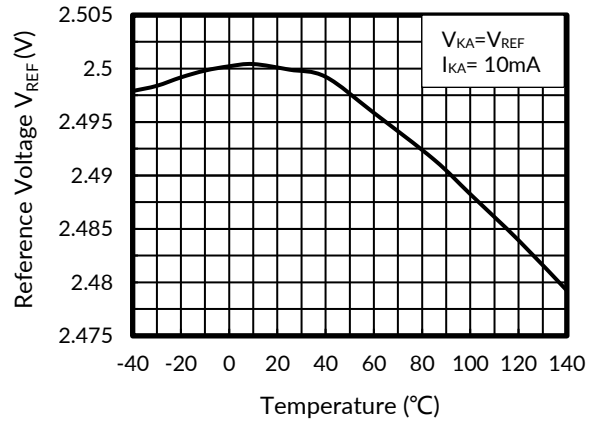
Figure 9. Small Signal Voltage Amplification vs Frequency

### TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

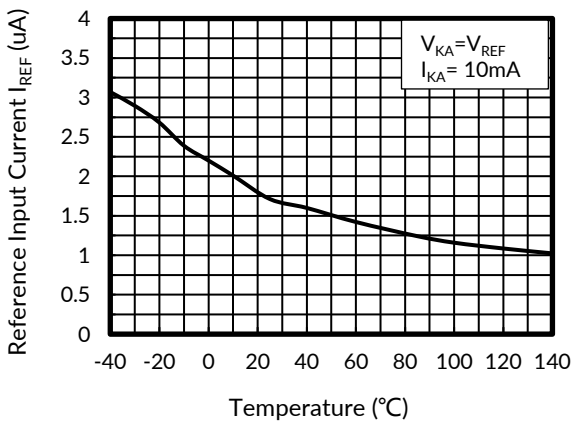
NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.



**Figure 10. Cathode Current vs Load Capacitance**



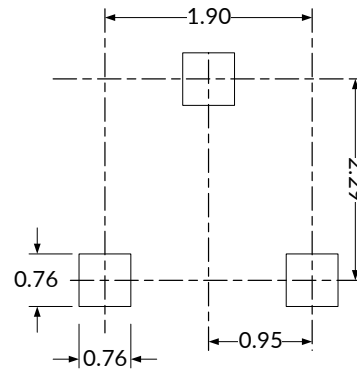
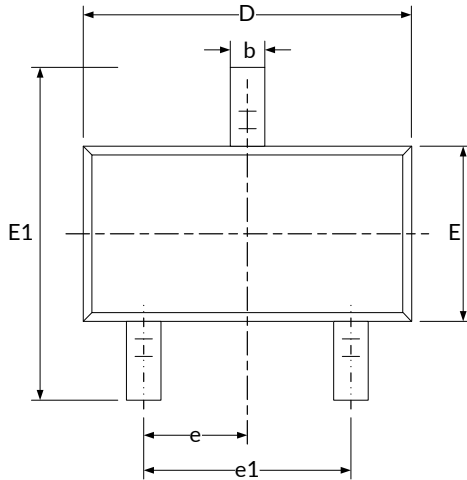
**Figure 11. Reference Voltage vs Ambient Temperature**



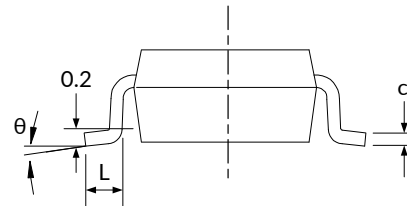
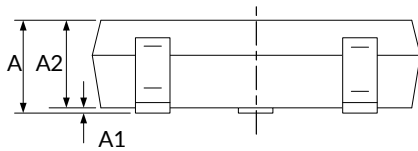
**Figure 12. Reference Input Current vs Ambient Temperature**

## 9 PACKAGE OUTLINE DIMENSIONS

### SOT23<sup>(3)</sup>



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A <sup>(1)</sup>	0.900	1.150	0.035	0.045
A1	0.000	0.100	0.000	0.004
A2	0.900	1.050	0.035	0.041
b	0.300	0.500	0.012	0.020
c	0.080	0.150	0.003	0.006
D <sup>(1)</sup>	2.800	3.000	0.110	0.118
E <sup>(1)</sup>	1.200	1.400	0.047	0.055
E1	2.250	2.550	0.089	0.100
e	0.950 (BSC) <sup>(2)</sup>		0.037 (BSC) <sup>(2)</sup>	
e1	1.800	2.000	0.071	0.079
L	0.300	0.500	0.012	0.020
$\theta$	0°	8°	0°	8°

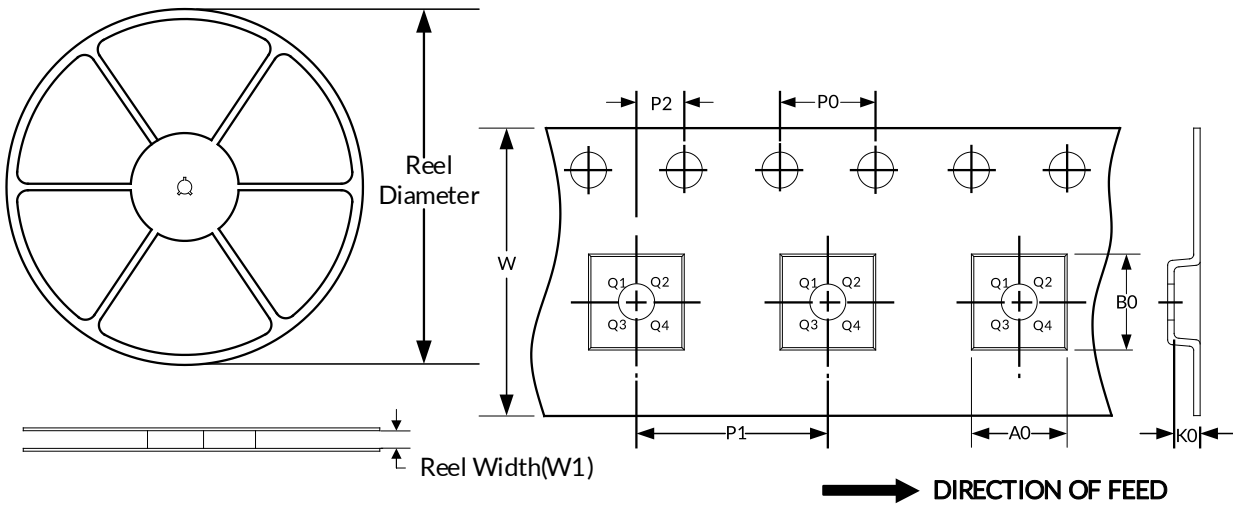
NOTE:

1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

## 10 TAPE AND REEL INFORMATION

### REEL DIMENSIONS

### TAPE DIMENSION



NOTE: The picture is only for reference. Please make the object as the standard.

### KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOT23	7"	9.5	3.15	2.77	1.22	4.0	4.0	2.0	8.0	Q3

NOTE:

1. All dimensions are nominal.
2. Plastic or metal protrusions of 0.15mm maximum per side are not included.

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