RS431-Q1/ RS432-Q1 Precision Programmable Reference

1 FEATURES

- **Qualified for Automotive Applications**
- **AEC-Q100 Qualified with the Grade 1**
- **Reference Voltage Tolerance at 25°C 0.5% (A Grade)**
- **Programmable Output Voltage to 32 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-Q1 and RS432-Q1 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 32V 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.

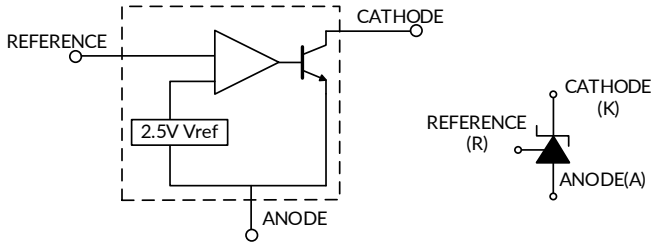
Both the RS431-Q1 and RS432-Q1 devices are offered in two grades, with initial tolerances (at 25°C) of 0.5%, for A grade.

Device Information (1)

PART NUMBER	PACKAGE(PIN)	BODY SIZE (NOM)
RS431-Q1	SOT23(3)	1.30mm×2.90mm
RS432-Q1	SOT23(3)	1.30mm×2.90mm

(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 different from page numbers in the current version.

Version	Change Date	Change Item
A.0	2023/03/06	Preliminary version completed
A.1	2023/10/23	Initial version completed

6 PACKAGE/ORDERING INFORMATION (1)

PRODUCT	ORDERING NUMBER	PACKAGE LEAD	VOLTAGE TOLERANCE	Lead finish/Ball material (2)	MSL Peak Temp (3)	PACKAGE MARKING (4)	PACKAGE OPTION
RS431-Q1	RS431AXSF3-Q1	SOT23	0.5%	NIPDAUAG	MSL1-260°-Unlimited	431A	Tape and Reel,3000
RS432-Q1	RS432AXSF3-Q1	SOT23	0.5%	NIPDAUAG	MSL1-260°-Unlimited	432A	Tape and Reel,3000

NOTE:

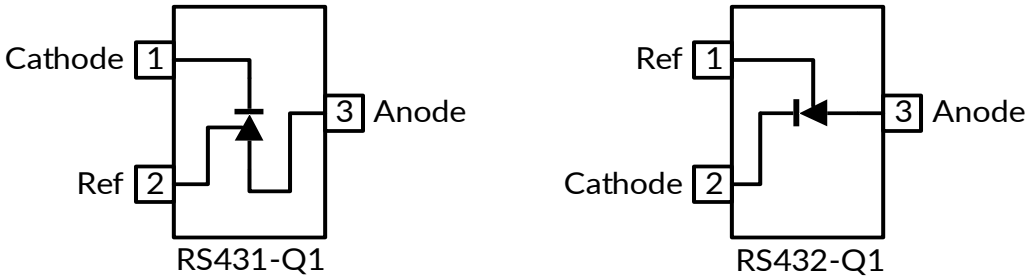
(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.

(2) Lead finish/Ball material. Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(3) MSL Peak Temp. The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the lot trace code information (data code and vendor code), the logo or the environmental category on the device.

7 Pin configuration and Functions (Top View)



Pin Description

NAME	PIN		DESCRIPTION
	RS431-Q1	RS432-Q1	
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) (1)(2)

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
Package Thermal Impedance (3)	SOT23	θ_{JA}		295	°C/W
Operating Junction Temperature (4)		T_{opr}	-40	+150	°C
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.

(4) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.

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 AEC Q100-002 (1)	±2000	V
	Charged-Device Model (CDM), per AEC Q100-011	±1000	
	Latch-Up (LU), per AEC Q100-004	±200	mA

(1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification.

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}	32	V
Cathode Current Range (Continuous)	I_{KA}	0.5	100	mA
Operating Ambient Temperature Range	T_A	-40	+125	°C

8.4 Electrical Characteristics (1)

(Over recommended operating conditions, Full= -40°C to +125°C, typical values are at T_A= +25°C, unless otherwise noted.)(2)

PARAMETER	SYMBOL	CONDITIONS		MIN (3)	TYP (4)	MAX (3)	UNIT
Reference Input Voltage	V_{REF}	V_{KA}=V_{REF}, I_{KA}=10mA	0.5%	2.488	2.50	2.512	V
Deviation of Reference Input Voltage Over Temperature (5)	ΔV_{REF}	V_{KA}=V_{REF}, I_{KA}=10mA T_A= -40°C ~ +125°C		-	20	60	mV
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	$\Delta V_{REF}/\Delta V_{KA}$	I_{KA}=10mA	ΔV_{KA}=10V~V_{REF}	-	-1.2	-2.0	mV/V
			ΔV_{KA}=32V~10V	-	-1.5	-2.0	
Reference Input Current	I_{REF}	I_{KA}=10mA, R1=10kΩ, R2=∞		-	1.7	4.0	uA
Deviation of Reference Input Current Over Full Temperature Range (5)	ΔI_{REF}	I_{KA}=10mA, R1=10kΩ, R2=∞ T_A= -40°C ~ +125°C		-	2	5	uA
Minimum Cathode Current for Regulation	I_{KA}(min)	V_{KA}=V_{REF}		-	0.3	0.5	mA
Off-State Cathode Current	I_{KA}(OFF)	V_{KA}=32V, V_{REF}=0V		-	0.05	0.5	uA
Dynamic Impedance	Z_{KA}	V_{KA}=V_{REF}, I_{KA}=1mA to100mA f≤1.0KHz		-	0.2	0.5	Ω

NOTE:

(1) The maximum current output of the device is controlled by the package power, the ambient temperature and the protection temperature of the PN junction.

(2) Electrical table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device.

(3) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.

(4) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.

(5) The deviation parameters (ΔVREF) and (ΔIREF) are defined as the differences between the maximum and minimum values obtained over the recommended temperature range for the same IC.

8.5 TYPICAL APPLICATIONS CIRCUIT

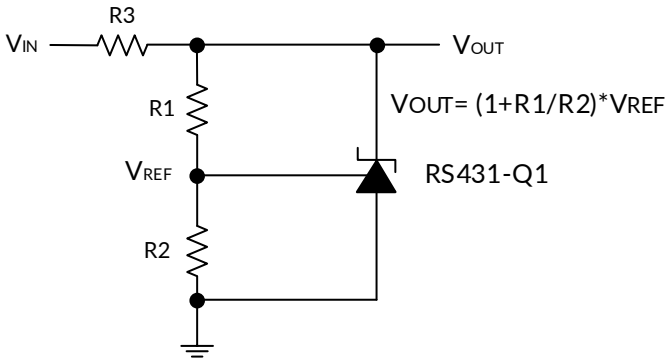


Figure 1. Shunt Regulator

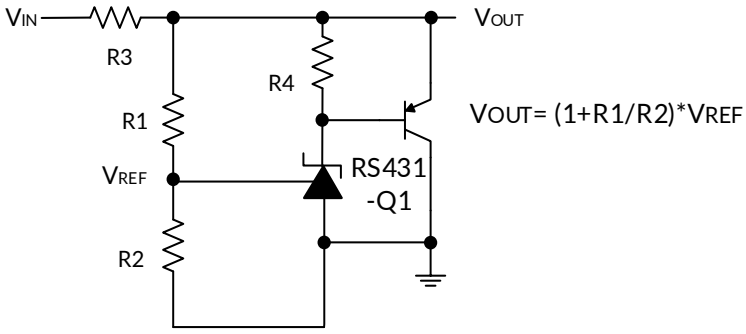


Figure 2. High Current Shunt Regulator

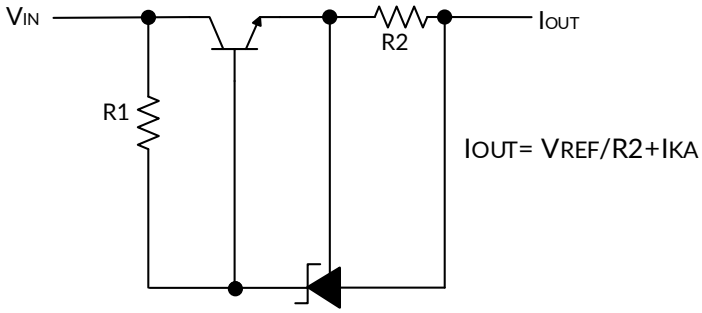


Figure 3. Current Source or Current Limit

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.

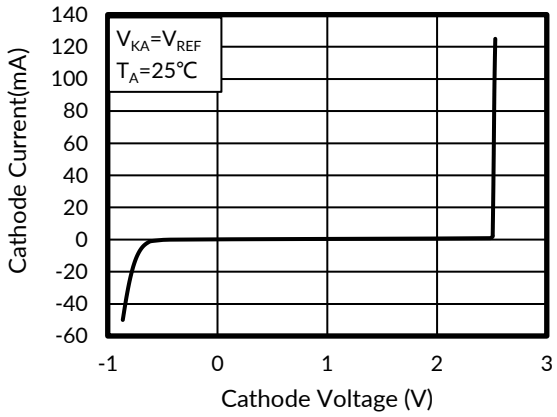


Figure 4. Cathode Current vs Cathode Voltage

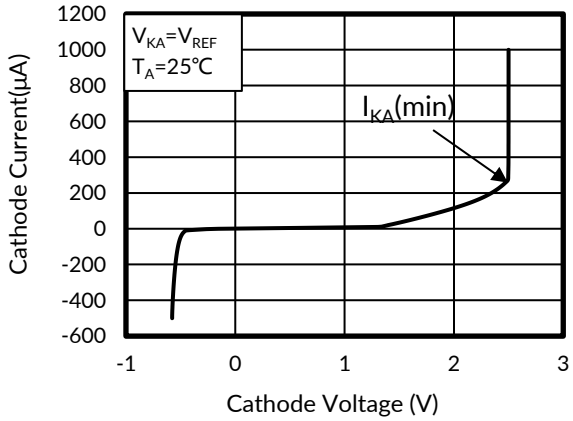


Figure 5. Cathode Current vs Cathode Voltage

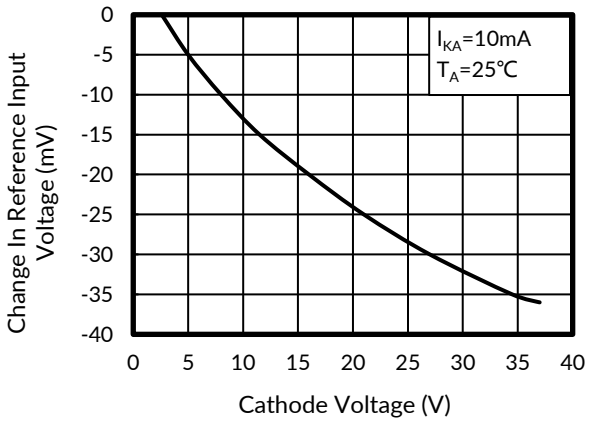


Figure 6. Change in Reference Input Voltage vs Cathode voltage

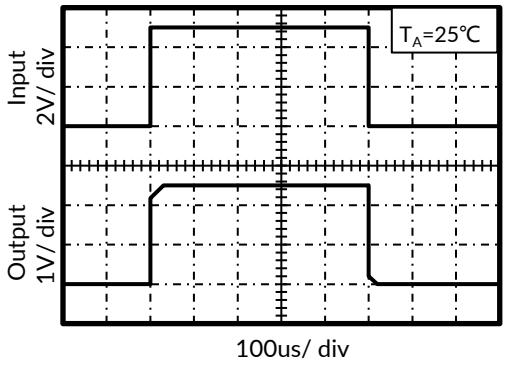


Figure 7. Pulse Response

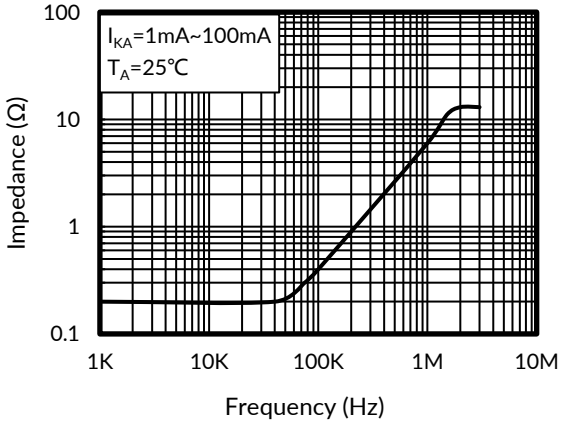


Figure 8. Dynamic Impedance vs Frequency

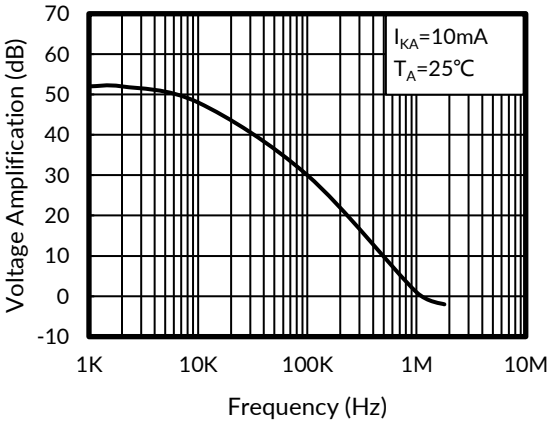


Figure 9. Small Signal Voltage Amplification vs Frequency

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.

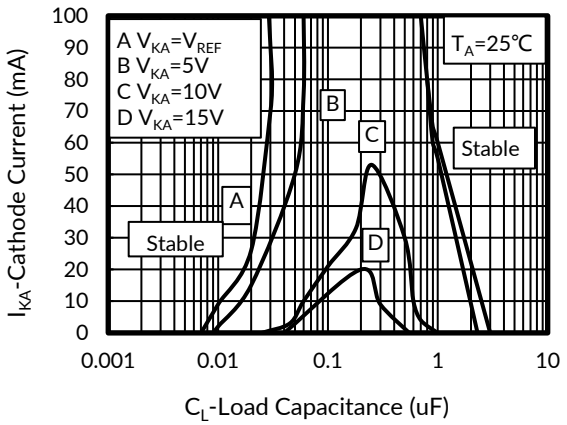


Figure 10. Cathode Current vs Load Capacitance

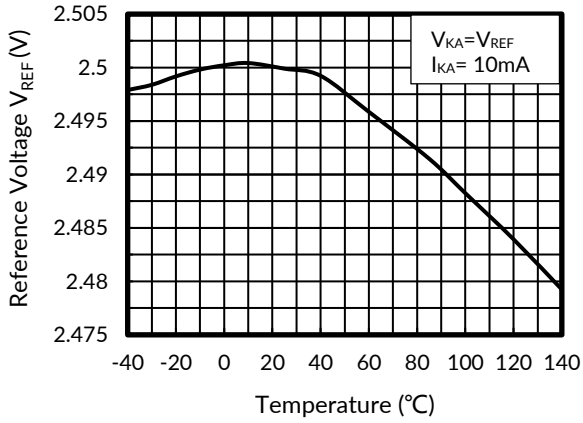


Figure 11. Reference Voltage vs Ambient Temperature

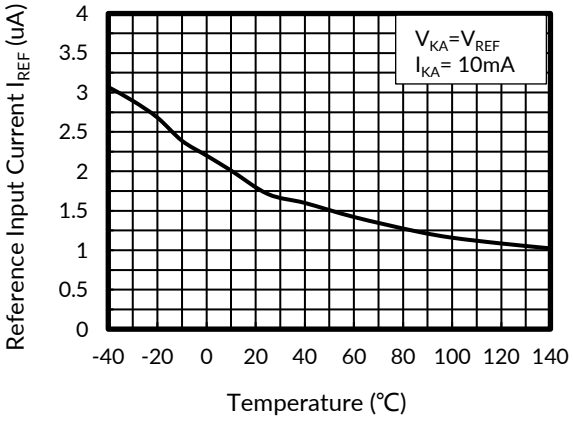
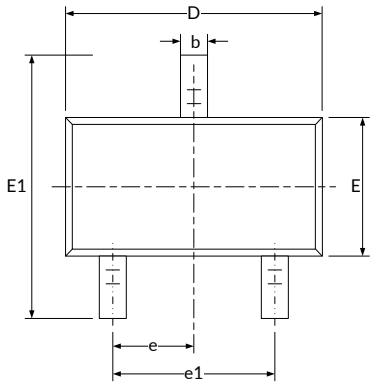
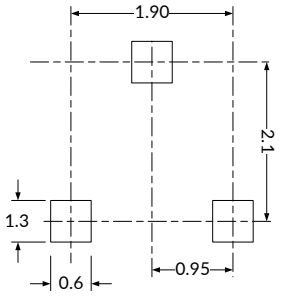


Figure 12. Reference Input Current vs Ambient Temperature

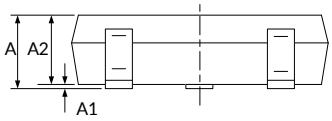
9 PACKAGE OUTLINE DIMENSIONS

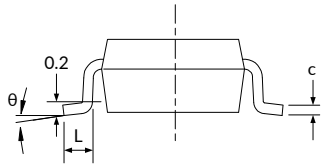
SOT23 (3)





RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	0.890	1.120	0.035	0.044
A1	0.000	0.100	0.000	0.004
A2	0.880	1.020	0.034	0.040
b	0.360	0.500	0.014	0.020
c	0.080	0.150	0.003	0.006
D (1)	2.800	3.000	0.110	0.118
E (1)	1.200	1.400	0.047	0.055
E1	2.350	2.640	0.092	0.104
e	0.950 (BSC) (2)		0.037 (BSC) (2)	
e1	1.800	2.000	0.071	0.079
L	0.400	0.600	0.015	0.024
θ	0°	8°	0°	8°

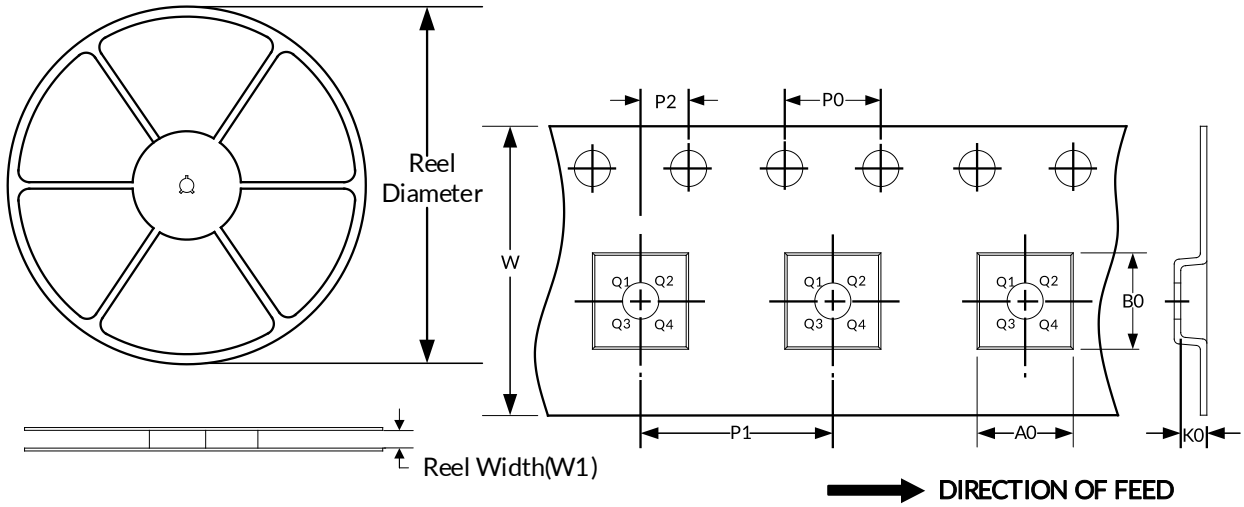
NOTE:

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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