AUTOMOTIVE COMPLIANT 1.24V ADJUSTABLE PRECISION SHUNT REGULATOR

Description

The AZ9431Q series are three-terminal adjustable shunt regulators with guaranteed thermal stability over a full operation range. These ICs feature sharp turn-on characteristics, low temperature coefficient, and low output impedance, which make them ideal substitutes for zener diodes in automotive and high-reliability applications requiring an improvement in zener performance.

The output voltage can be set to any value between 1.24V and 18V with two external resistors.

The AZ9431Q precision reference is offered in 0.5% and 1.0% voltage tolerance.

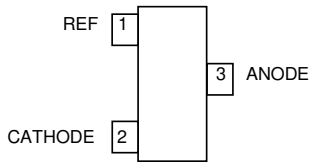
The AZ9431Q are available in SOT23 that are qualified to AEC-Q100 standards for high reliability and are PPAP capable.

Features

- Wide Programmable Precise Output Voltage from 1.24V to 18V
- Temperature Range -40°C to +125°C
- Reference Voltage Tolerance at +25°C
  - 0.5% AZ9431AQSA-7
  - 1% AZ9431BQSA-7
- High Stability Under Capacitive Load
- Low Temperature Deviation: 3mV Typical
- Low Equivalent Full-Range Temperature Coefficient: 20PPM/°C
- Low Dynamic Output Resistance: 0.05Ω Typical
- High-Sink Current Capacity from 0.1mA to 100mA
- Low Output Noise
- Wide Operating Range of -40°C to +125°C
- Green Molding
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **The AZ9431Q series are suitable for automotive applications requiring specific change control; these parts are AEC-Q100 qualified, PPAP capable, and manufactured in IATF 16949 certified facilities.**
  https://www.diodes.com/quality/product-definitions/

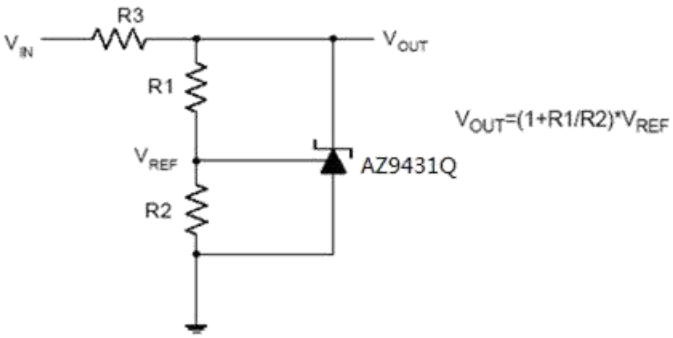
Pin Assignments

SOT23



(Top View)

Typical Applications Circuit



Shunt Regulator

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

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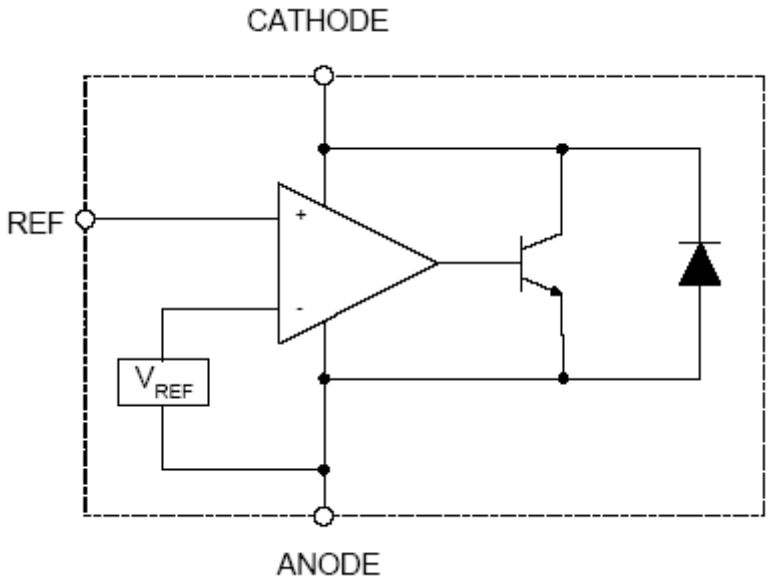
Functional Block Diagram



Absolute Maximum Ratings (Note 4)

Symbol	Parameter	Rating	Unit
V_{KA}	Cathode Voltage	20	V
I_{KA}	Cathode Current Range (Continuous)	-100 to 100	mA
I_{REF}	Reference Input Current Range	10	mA
P_D	Power Dissipation	370	mW
T_J	Junction Temperature	+150	ºC
T_{STG}	Storage Temperature Range	-65 to +150	ºC

Note: 4. Stresses greater than those listed under *Absolute Maximum Ratings* can 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 Ratings* for extended periods can affect device reliability.

ESD Susceptibility		
Human Body Model	±6	kV
Machine Model	±300	V
Charged Device Model	±1.5	kV

Semiconductor devices are ESD sensitive and can be damaged by exposure to ESD events. Suitable ESD precautions must be taken when handling and transporting these devices.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{KA}	Cathode Voltage	V_{REF}	18	V
I_{KA}	Cathode Current	0.1	100	mA
T_A	Operating Ambient Temperature Range	-40	+125	ºC

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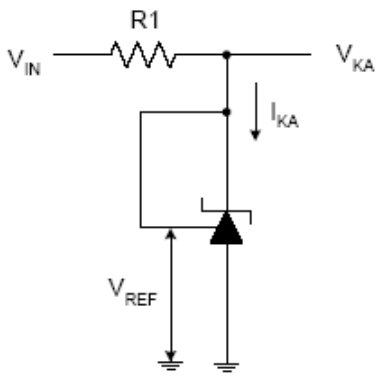
Electrical Characteristics (Operating Conditions: T_A = +25 ºC, unless otherwise noted.)

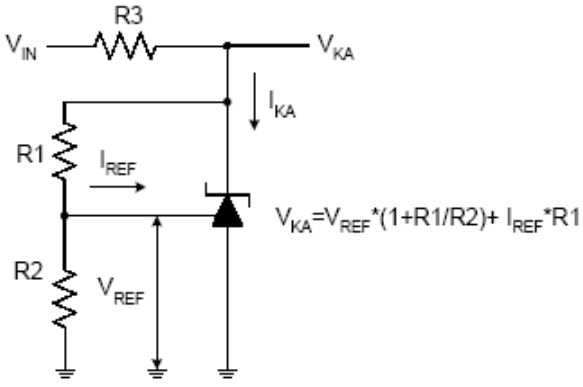
Symbol	Parameter		Test Circuit	Conditions		Min	Typ	Max	Unit
V_{REF}	Reference Voltage	0.5%	4	$V_{KA} = V_{REF}$, I_{KA} = 10mA	AZ9431AQ	1.234	1.24	1.246	V
		1.0%	4	$V_{KA} = V_{REF}$, I_{KA} = 10mA	AZ9431BQ	1.228	1.24	1.252	V
ΔV_{REF}	Deviation of Reference Voltage Over Full Temperature Range		4	$V_{KA} = V_{REF}$, I_{KA} = 10mA	0°C to +70°C	—	2	10	mV
					-40°C to +85°C	—	3	10	
					-40°C to +125°C	—	4	15	
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of Change in V_{REF} to the Change in Cathode Voltage		5	I_{KA} = 10mA, ΔV_{KA}: V_{REF} to 16V		—	-0.5	-1.5	mV/V
I_{REF}	Reference Input Current		5	I_{KA} = 10mA, R1 = 10KΩ, R2 = ∞		—	0.15	0.4	µA
ΔI_{REF}	Deviation of Reference Current Overfull Temperature Range		5	I_{KA} = 10mA, R1 = 10KΩ, R2 = ∞, T_A = -40°C to +125°C		—	0.1	0.4	µA
I_{KA} (Min)	Minimum Cathode Current for Regulation		4	$V_{KA} = V_{REF}$		—	55	80	µA
I_{KA} (Off)	Off-State Cathode Current		6	V_{REF} = 0, V_{KA} = 18V		—	0.04	0.10	µA
				V_{KA} = 6V, V_{REF} = 0		—	0.01	0.05	
Z_{KA}	Dynamic Impedance		4	$V_{KA} = V_{REF}$, I_{KA} = 1mA to 100mA, f ≤ 1.0kHz		—	0.05	0.15	Ω
θ_{JC}	Thermal Resistance (Note 5)		—	—		—	45	—	°C/W

Note: 5. Test condition for SOT23: device mounted on 1"x1" FR-4 MRP substrate PCB, 2oz copper, with minimum recommended pad layout.

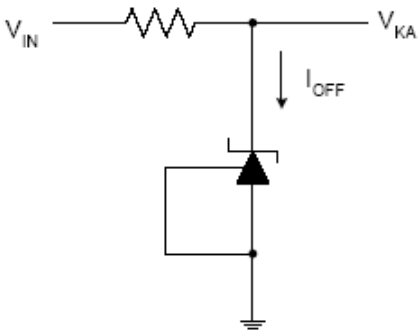
Test Circuits



Test Circuit 4 for $V_{KA} = V_{REF}$



Test Circuit 5 for $V_{KA} > V_{REF}$



Test Circuit 6 for I_{OFF}

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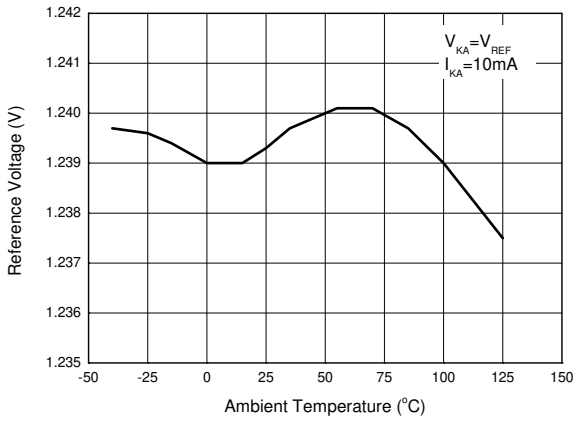
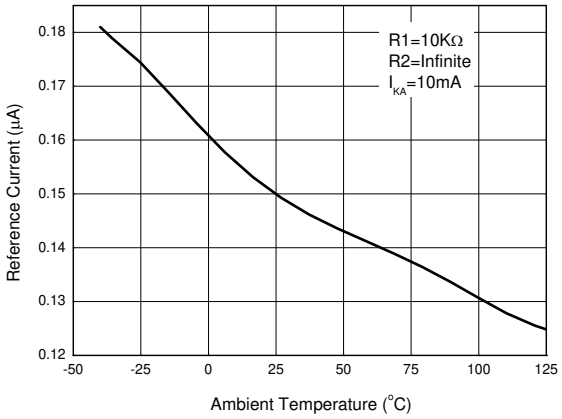
Performance Characteristics

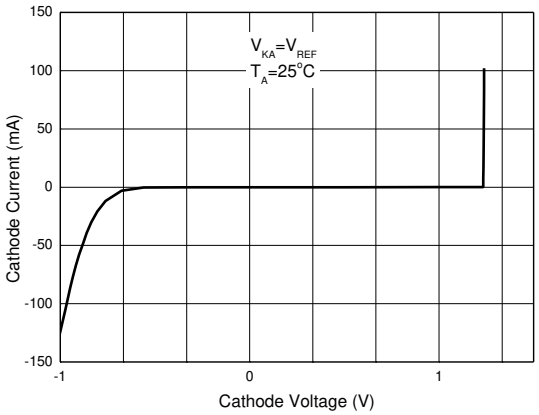
Reference Voltage vs. Ambient Temperature



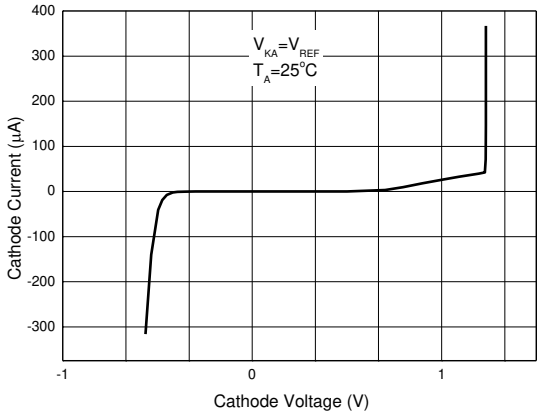
Reference Current vs. Ambient Temperature



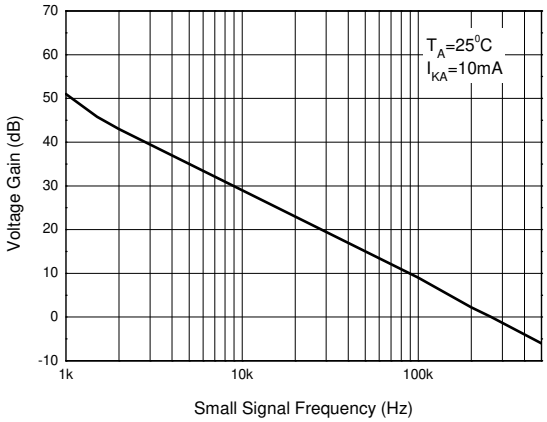
Cathode Current vs. Cathode Voltage

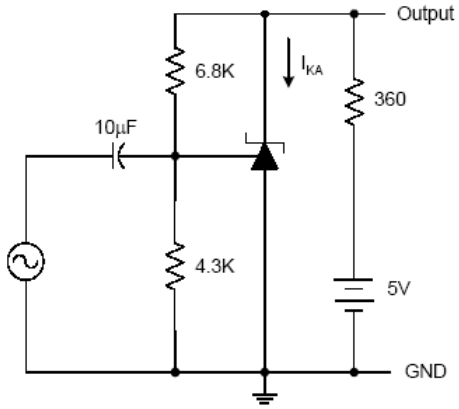


Cathode Current vs. Cathode Voltage



Small Signal Voltage Gain vs. Frequency





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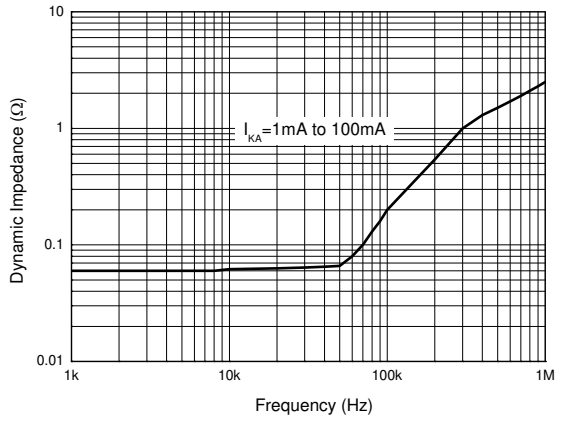
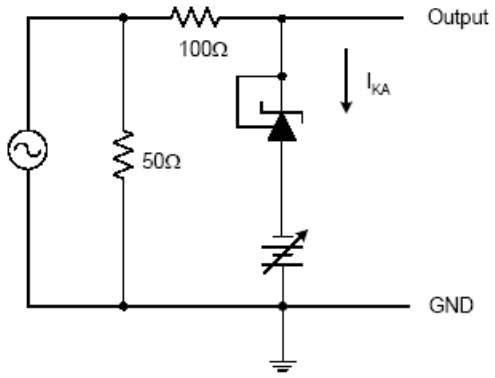
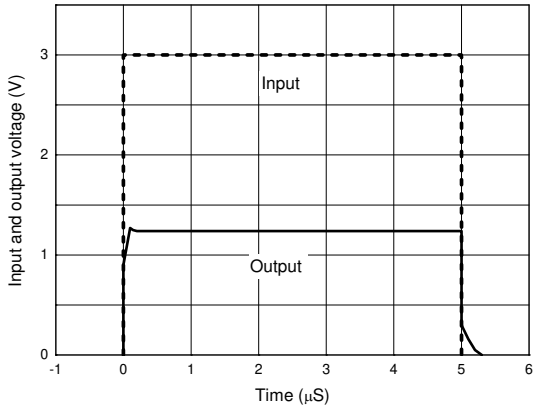
Performance Characteristics (continued)

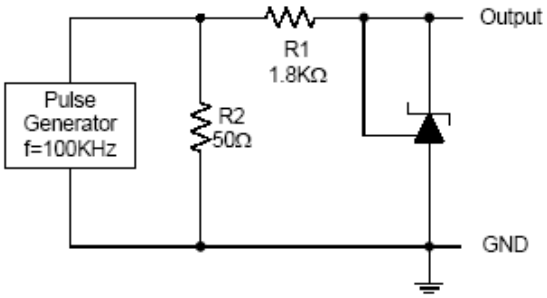
Dynamic Impedance vs. Frequency



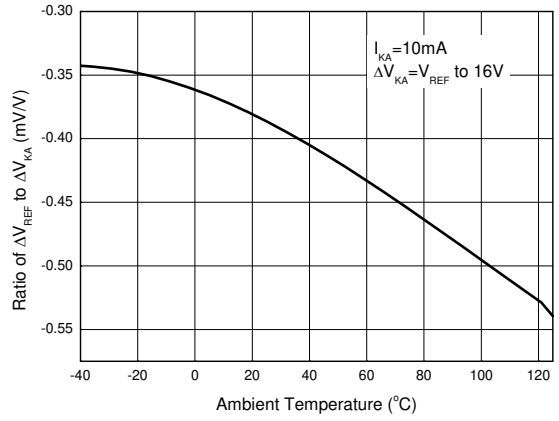


Pulse Response of Input and Output Voltage

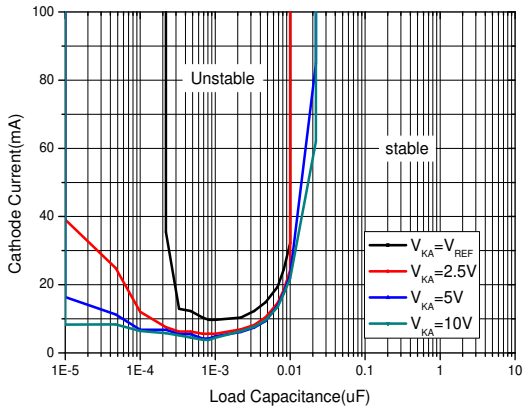




Ratio of Delta Reference Voltage to the Ratio of Cathode Voltage vs. Ambient Temperature



Stability Boundary Conditions vs. Load Capacitance



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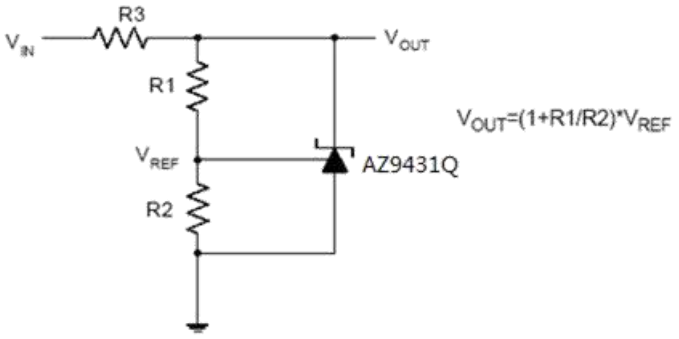
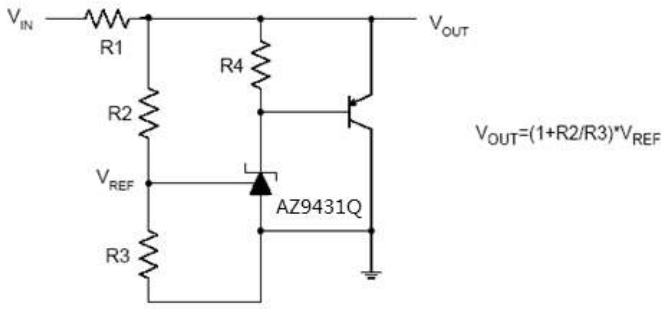
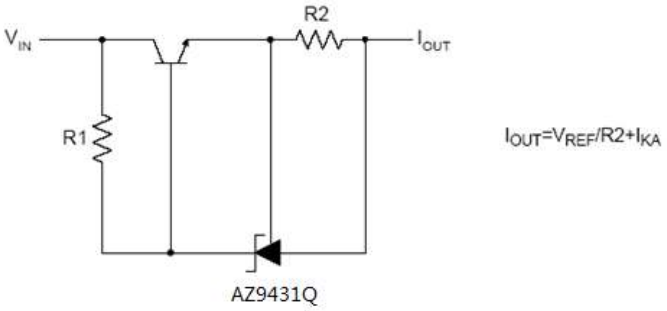
Typical Applications Circuit



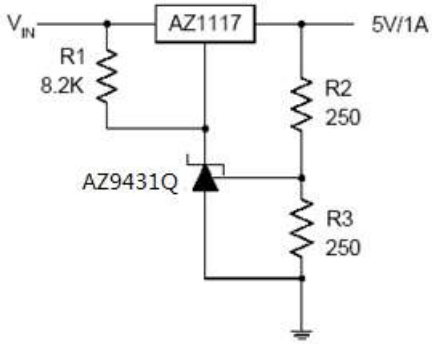
Shunt Regulator



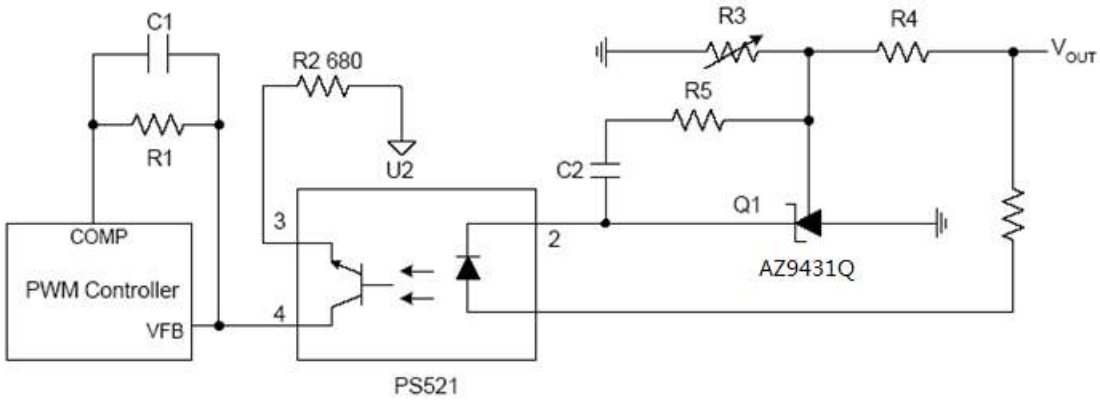
High Current Shunt Regulator



Current Source or Current Limit



Precision 5V 1A Regulator



PWM Converter with Reference

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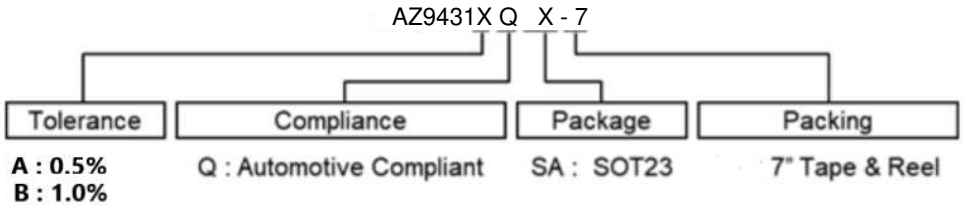
Ordering Information



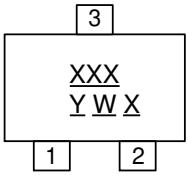
Part Number	Package Code	Package (Note 6)	Compliance (Note 7)	Packing	
				Qty.	Carrier
AZ9431AQ	SA	SOT23	Automotive Compliant	3000	7" Tape & Reel
AZ9431BQ	SA	SOT23	Automotive Compliant	3000	7" Tape & Reel

Notes: 6. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.
7. AZ9431Q have been qualified to AEC-Q100 Grade 1 and are classified as *Automotive-Compliant* supporting PPAP documentation. See AZ431L datasheet for commercial qualified versions.

Marking Information

SOT23

(Top View)



XXX : Identification Code
Y : Year 0 to 9
W : Week : A to Z : 1 to 26 week;
a to z : 27 to 52 week; z represents 52 and 53 week
X : Internal Code

Part Number	Package	Identification Code
AZ9431AQSA-7	SOT23	DXQ
AZ9431BQSA-7	SOT23	DYQ

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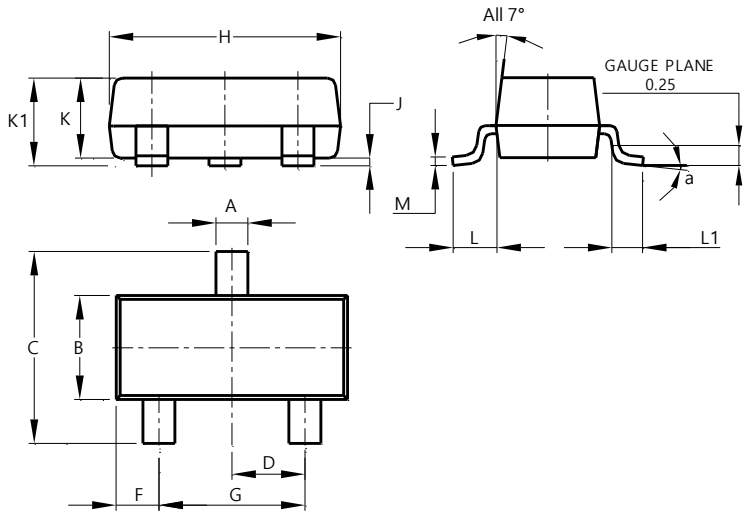
Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

SOT23

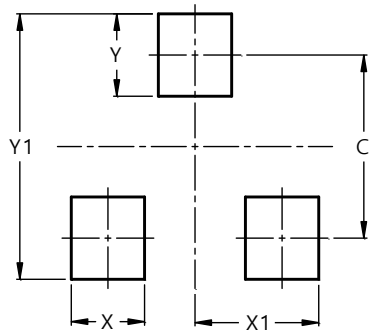


SOT23			
Dim	**Min**	**Max**	**Typ**
A	0.37	0.51	0.40
B	1.20	1.40	1.30
C	2.30	2.50	2.40
D	0.89	1.03	0.915
F	0.45	0.60	0.535
G	1.78	2.05	1.83
H	2.80	3.00	2.90
J	0.013	0.10	0.05
K	0.890	1.00	0.975
K1	0.903	1.10	1.025
L	0.45	0.61	0.55
L1	0.25	0.55	0.40
M	0.085	0.150	0.110
a	0°	8°	--
All Dimensions in mm			

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

SOT23



Dimensions	Value (in mm)
C	2.0
X	0.8
X1	1.35
Y	0.9
Y1	2.9

Note: 8. The suggested land pattern dimensions have been provided for reference only, as actual pad layouts may vary depending on application. These dimensions may be modified based on user equipment capability or fabrication criteria. A more robust pattern may be desired for wave soldering and is calculated by adding 0.2 mm to the 'Z' dimension. For further information, please reference document IPC-7351A, Naming Convention for Standard SMT Land Patterns, and for International grid details, please see document IEC, Publication 97.

Mechanical Data

- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.009 grams (Approximate)

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