

### Features

- Temperature-compensated: 30 ppm/°C
- Trimmed bandgap reference
- Internal amplifier with 150 mA capability
- Multiple temperature ranges
- Low frequency dynamic output impedance: < 150 mΩ
- Low output noise
- Robust ESD protection
- Available in Lead Free (ROHS Compliant) version.

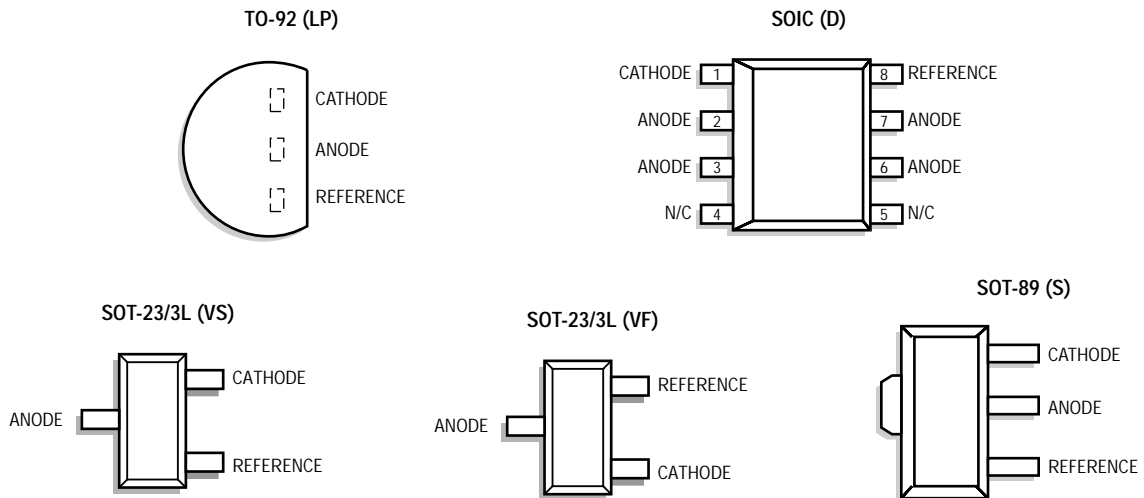
### Description

The AS431S is a three-terminal adjustable shunt regulator providing a highly accurate bandgap reference. The adjustable shunt regulator is ideal for a wide variety of linear applications that can be implemented using external components to obtain adjustable currents and voltages.

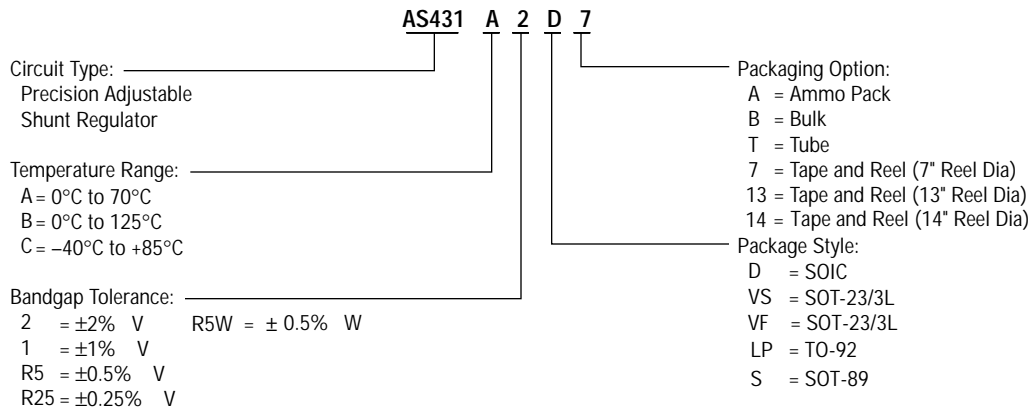
In the standard shunt configuration, the combination of low temperature coefficient (TC), sharp turn-on characteristics, low output impedance and programmable output voltage make this precision reference a perfect zener diode replacement.

The AS431S precision adjustable shunt reference is offered in four bandgap tolerances:  $\pm 0.25\%$ ,  $\pm 0.5\%$ ,  $\pm 1.0\%$ , and  $\pm 2.0\%$ .

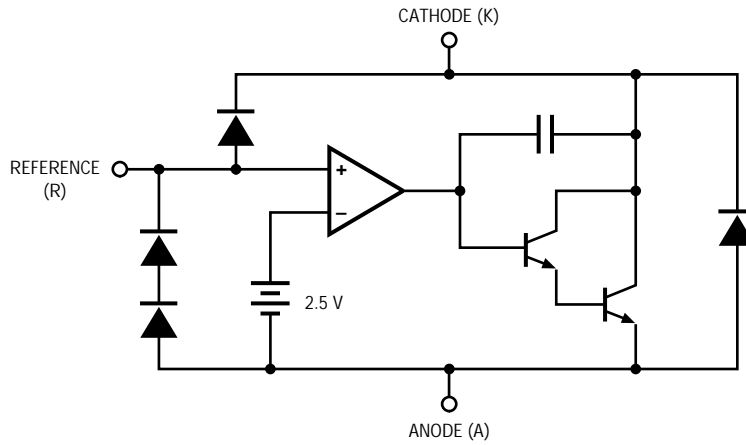
### Pin Configuration — Top view



### Ordering Information



## Functional Block Diagram



## Absolute Maximum Ratings

Parameter	Symbol	Rating	Units
Cathode-Anode Reverse Breakdown	$V_{KA}$	37	V
Anode-Cathode Forward Current	$I_{AK}$	1	A
Operating Cathode Current	$I_{KA}$	150	mA
Reference Input Current	$I_{REF}$	10	mA
Continuous Power Dissipation at 25°C	$P_D$		
TO-92		775	mW
8L SOIC		750	mW
SOT-89		1000	mW
SOT-23/3L		200	mW
Junction Temperature	$T_J$	150	°C
Storage Temperature	$T_{STG}$	-65 to 150	°C
Lead Temperature, Soldering 10 Seconds	$T_L$	300	°C

Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## Recommended Conditions

Parameter	Symbol	Rating	Unit
Cathode Voltage	$V_{KA}$	$V_{REF}$ to 20	V
Cathode Current	$I_K$	10	mA

## Typical Thermal Resistances

Package	$\theta_{JA}$	$\theta_{JC}$	Typical Derating
TO-92	160°C/W	80°C/W	6.3 mW/°C
SOIC	175°C/W	45°C/W	5.7 mW/°C
SOT-89	110°C/W	8°C/W	9.1 mW/°C
SOT-23/3L	575°C/W	150°C/W	1.7 mW/°C

**Electrical Characteristics**

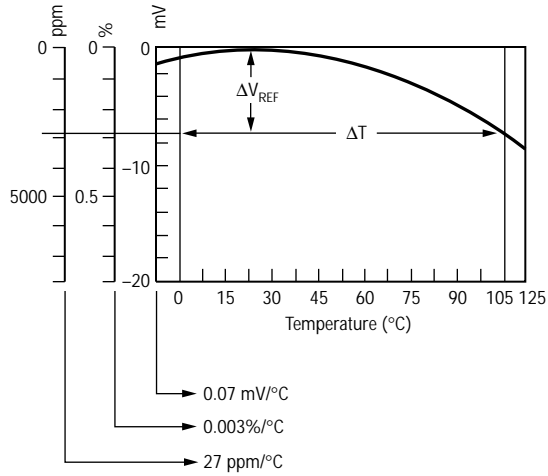
Electrical Characteristics are guaranteed over full junction temperature range (0 to 125°C). Ambient temperature must be derated based on power dissipation and package thermal characteristics. The conditions are:  $V_{KA} = V_{REF}$  and  $I_K = 10$  mA unless otherwise stated.

Parameter	Symbol	Test Condition	AS431 (0.25%)			AS431 (0.5%)			Unit	Test Circuit
			Min.	Typ.	Max.	Min.	Typ.	Max.		
Reference Voltage	$V_{REF}$	$T_A = 25^\circ\text{C}$	2.496	2.503	2.509	2.490	2.503	2.515	V	1
		Over temp.	2.475		2.530	2.469		2.536	V	1
$\Delta V_{REF}$ with Temp*	TC			0.07	0.20		0.07	0.20	mV/°C	1
Ratio of Change in $V_{REF}$ to Cathode Voltage	$\frac{\Delta V_{REF}}{\Delta V_K}$	$V_{REF}$ to 10 V	-2.7	-1.0		-2.7	-1.0		mV/V	2
		10 V to 36 V	-2	-0.4	0.3	-2	-0.4	0.3		
Reference Input Current	$I_{REF}$			0.7	4		0.7	4	$\mu\text{A}$	2
$I_{REF}$ Temp Deviation	$\Delta I_{REF}$	Over temp.		0.4	1.2		0.4	1.2	$\mu\text{A}$	2
Min $I_K$ for Regulation	$I_{K(\text{min})}$			0.4	1		0.4	1	mA	1
Off State Leakage	$I_{K(\text{off})}$	$V_{REF} = 0$ V, $V_{KA} = 36$ V		0.04	250		0.04	250	nA	3
Dynamic Output Impedance	$Z_{KA}$	$f \leq 1$ kHz $I_K = 1$ to 150 mA		0.15	0.5		0.15	0.5	$\Omega$	1

Parameter	Symbol	Test Condition	AS431 (1.0%)			AS431 (0.5%)W			Unit	Test Circuit
			Min.	Typ.	Max.	Min.	Typ.	Max.		
Reference Voltage	$V_{REF}$	$T_A = 25^\circ\text{C}$	2.470	2.495	2.520	2.510	2.522	2.595	V	1
		Over temp.	2.449		2.541	2.488		2.556	V	1
$\Delta V_{REF}$ with Temp*	TC			0.07	0.20		0.07	0.20	mV/°C	1
Ratio of Change in $V_{REF}$ to Cathode Voltage	$\frac{\Delta V_{REF}}{\Delta V_K}$	$V_{REF}$ to 10 V	-2.7	-1.0		-2.7	-1.0		mV/V	2
		10 V to 36 V	-2	-0.4	0.3	-2	-0.4	0.3		
Reference Input Current	$I_{REF}$			0.7	4		0.7	4	$\mu\text{A}$	2
$I_{REF}$ Temp Deviation	$\Delta I_{REF}$	Over temp.		0.4	1.2		0.4	1.2	$\mu\text{A}$	2
Min $I_K$ for Regulation	$I_{K(\text{min})}$			0.4	1		0.4	1	mA	1
Off State Leakage	$I_{K(\text{off})}$	$V_{REF} = 0$ V, $V_{KA} = 36$ V		0.04	250		0.04	250	nA	3
Dynamic Output Impedance	$Z_{KA}$	$f \leq 1$ kHz $I_K = 1$ to 150 mA		0.15	0.5		0.15	0.5	$\Omega$	1

\*Calculating Average Temperature Coefficient (TC). Refer to following page.

Average Temperature Coefficient



- TC in mV/°C =  $\frac{\Delta V_{REF} \text{ (mV)}}{\Delta T_A}$
- TC in %/°C =  $\frac{\left(\frac{\Delta V_{REF}}{V_{REF} \text{ at } 25^\circ\text{C}}\right) \times 100}{\Delta T_A}$
- TC in ppm/°C =  $\frac{\left(\frac{\Delta V_{REF}}{V_{REF} \text{ at } 25^\circ\text{C}}\right) \times 10^6}{\Delta T_A}$

Test Circuits

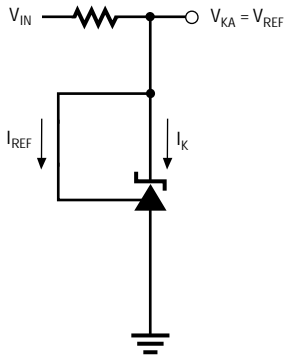


Figure 1a. Test Circuit 1

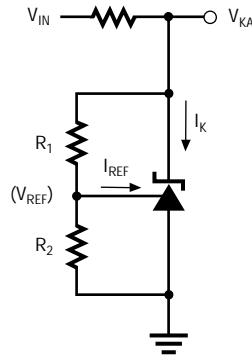


Figure 1b. Test Circuit 2

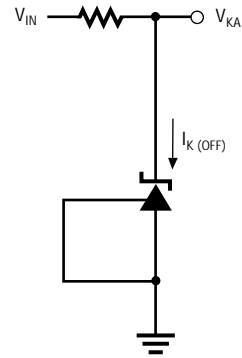


Figure 1c. Test Circuit 3

Typical Performance Curves

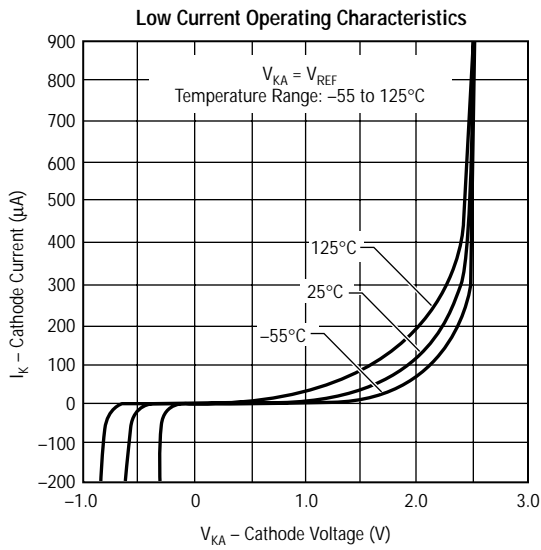


Figure 2

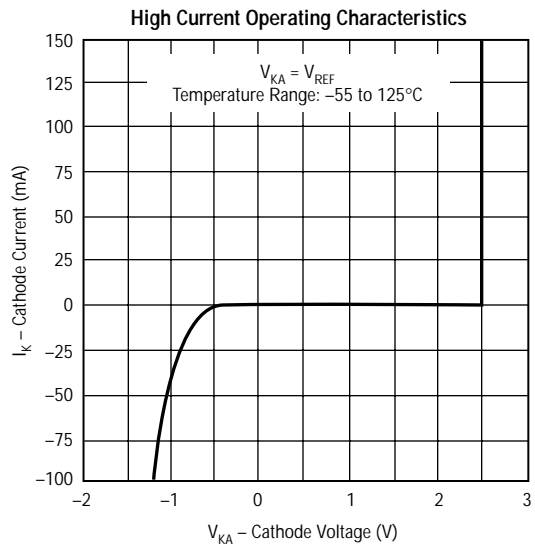


Figure 3

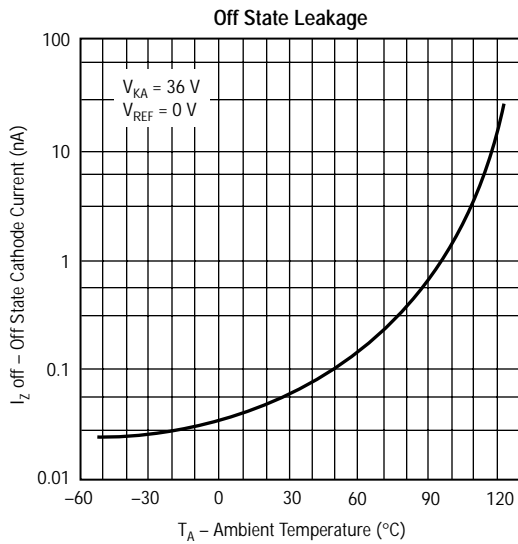


Figure 4

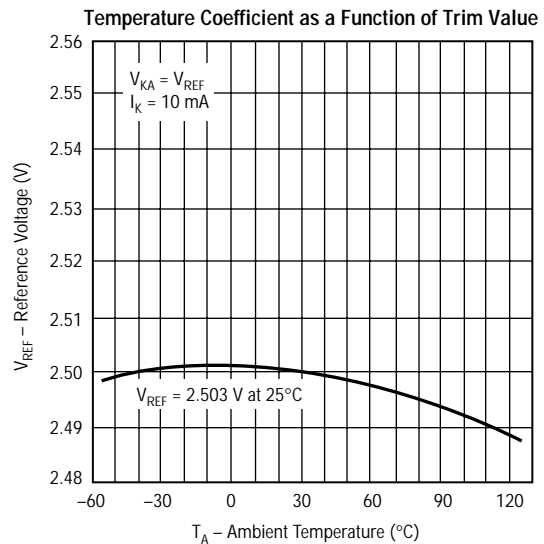


Figure 5

Typical Performance Curves

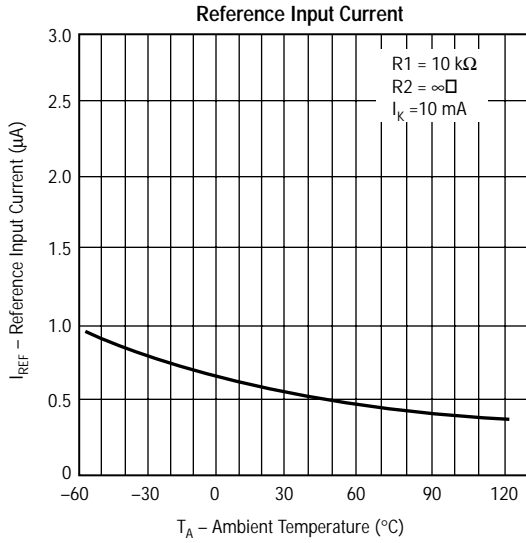


Figure 6

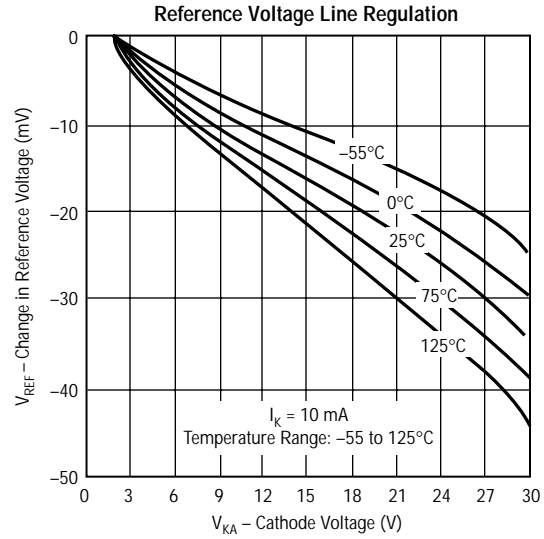


Figure 7

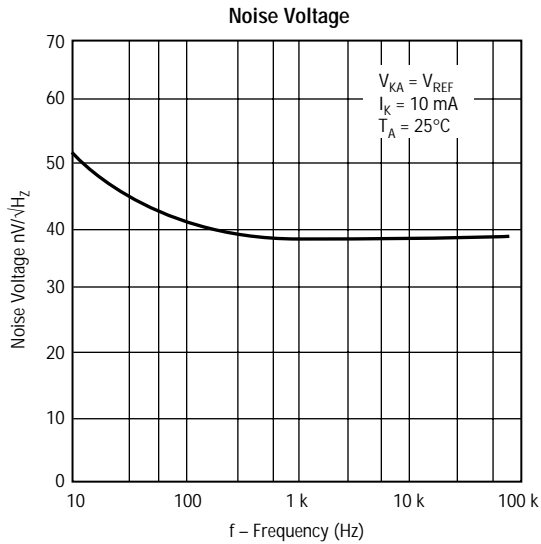


Figure 8

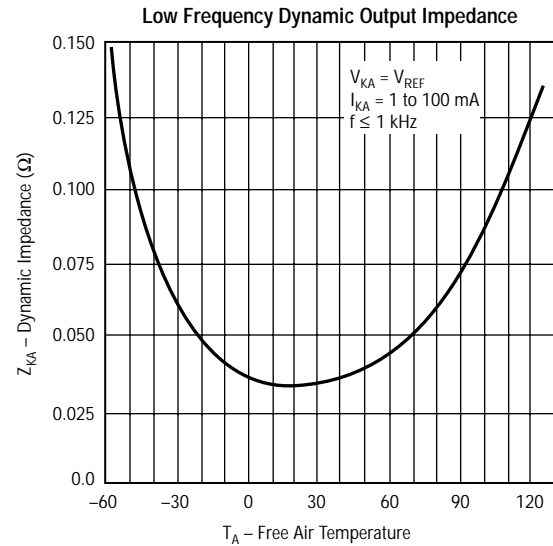


Figure 9

Typical Performance Curves

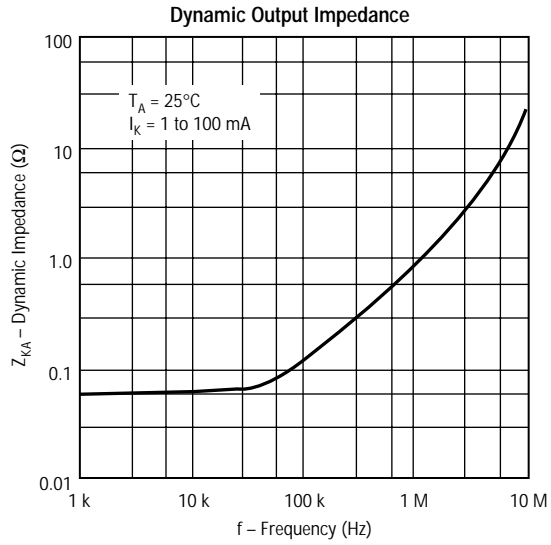


Figure 10

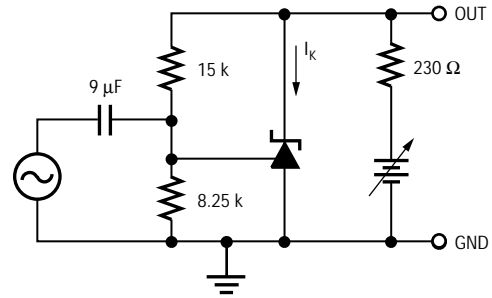
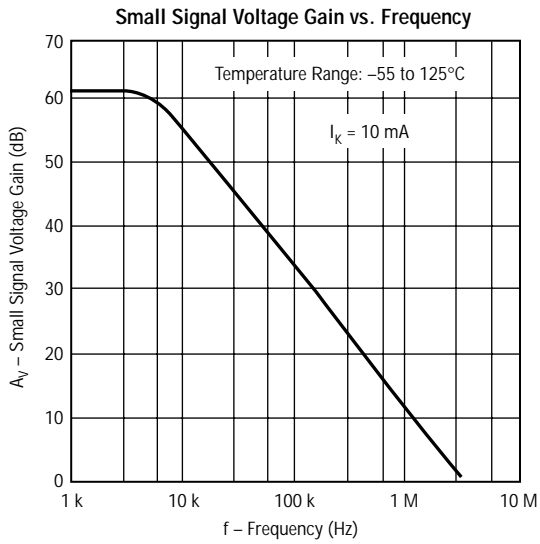


Figure 11

Typical Performance Curves

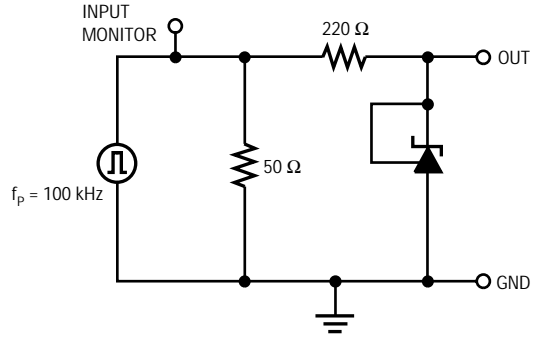
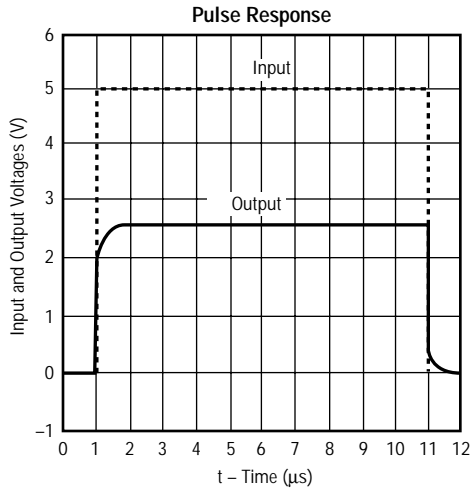


Figure 12

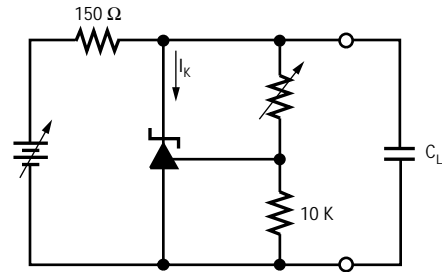
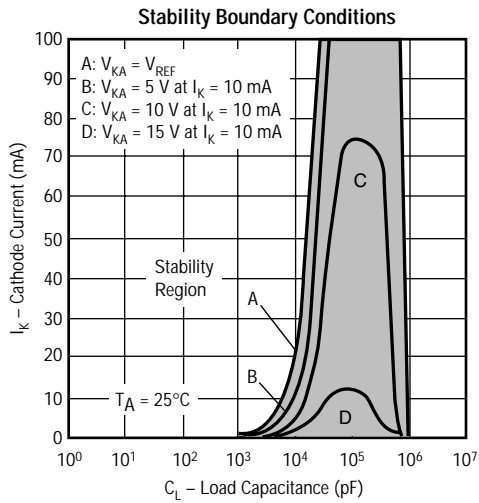
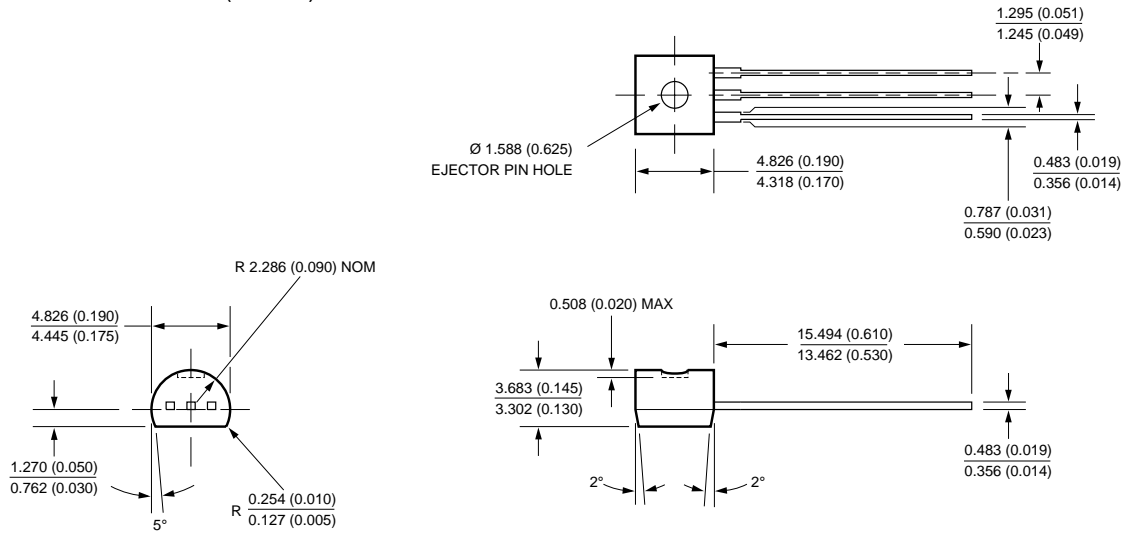
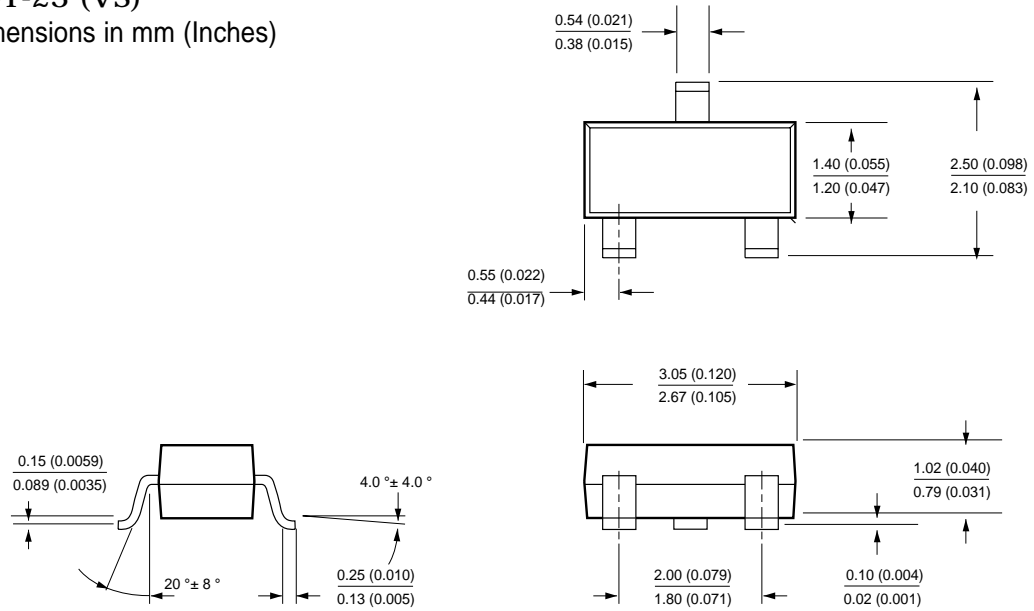


Figure 13

TO-92 PLASTIC (LP)  
Dimensions in mm (Inches)

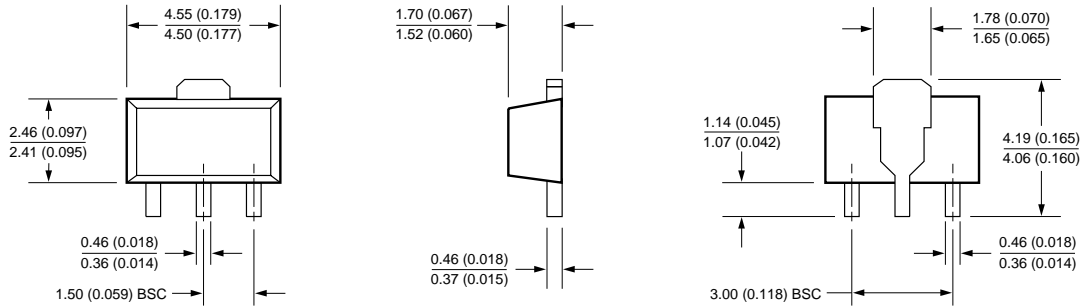


SOT-23 (VS)  
Dimensions in mm (Inches)



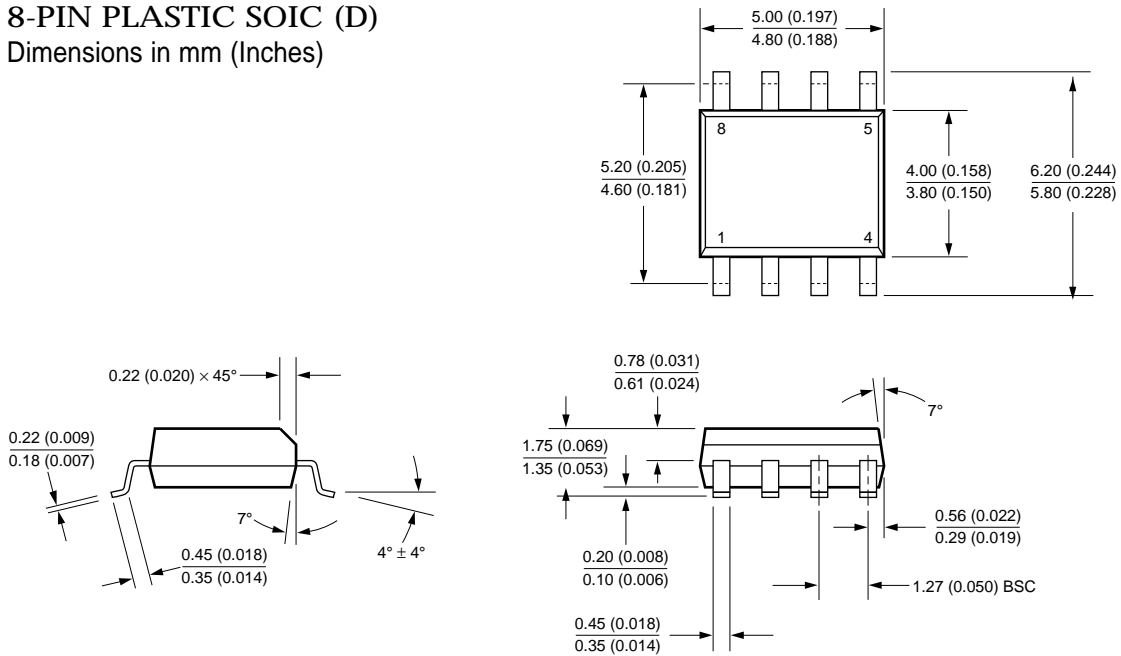
SOT-89 (S)

Dimensions in mm (Inches)

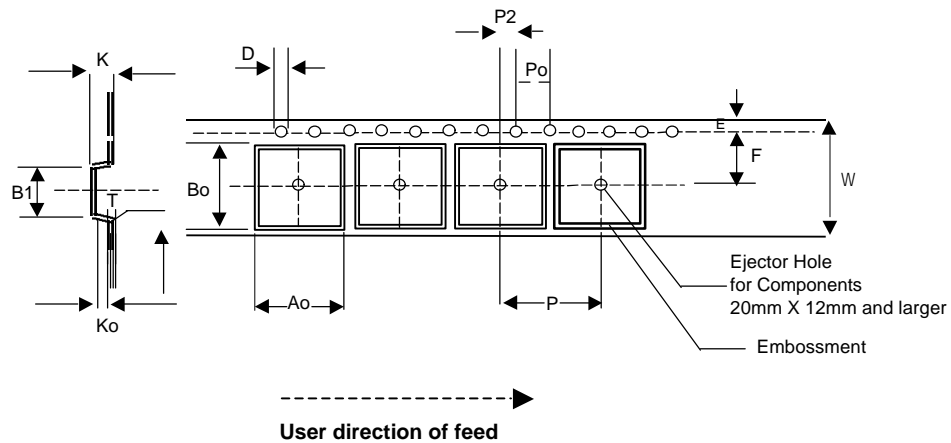


8-PIN PLASTIC SOIC (D)

Dimensions in mm (Inches)



Surface Mountable Tape & Reel Specifications in mm ( inch )  
 ( SOIC, SOT-89, SOT-23 )

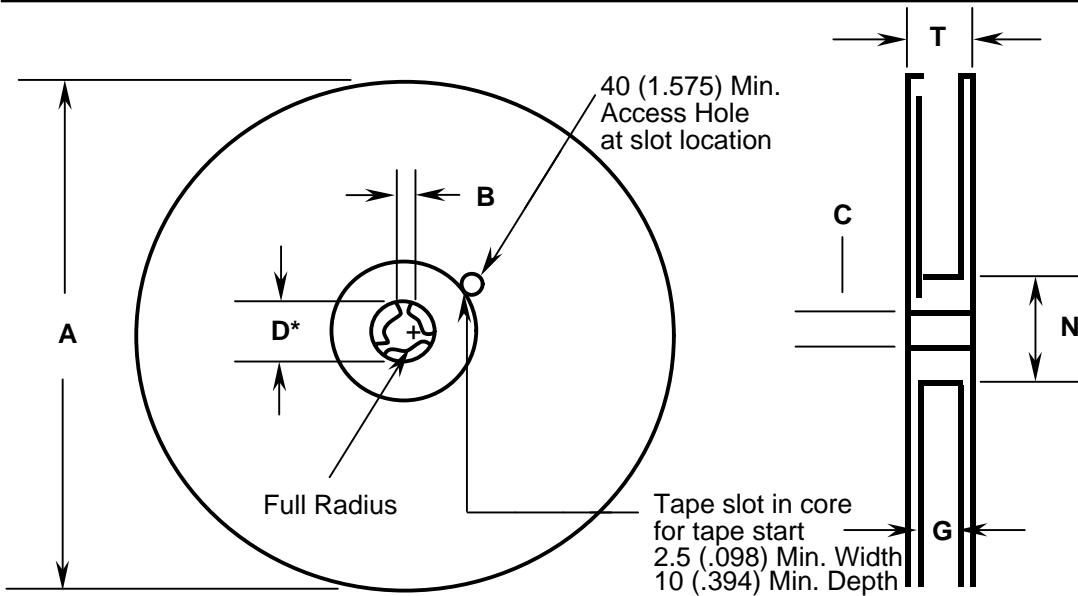


Tape Size (W)	D	E	P <sub>0</sub>	T (Max)	A <sub>0</sub> , B <sub>0</sub> , K <sub>0</sub>	T <sub>1</sub> (Max)	Constant Dimensions
8, 12, 16, 24mm	1.55±0.05 (.061±.002)	1.75±0.10 (.069±.004)	4.0±0.10 (.157±.004)	0.400 (.016)	See Note	0.100 (.004)	

Tape Size (W)	B <sub>1</sub> Max.	D <sub>1</sub> Min.	F	K Max.	P <sub>2</sub>	
8 mm	4.2 (.165)	1.0 (.039)	3.5±0.05 (.138±.002)	2.4 (.094)	2.0±.05	
12 mm	8.2 (.323)	1.5 (.059)	5.5±0.05 (.217±.002)	4.5 (.177)	.079±.002	Variable Dimensions

Per Package Requirement						
Components		Tape Width (W) mm	Cavity Pitch (P) mm	Devices per Reel		
				7" Reel	13" Reel	14" Reel
SOIC	8L	12	8	-	2500	-
SOT-23	3L	8	4	3000	-	-
	5L	8	4	3000	-	-
SOT-89	4L	12	8	-	2500	-

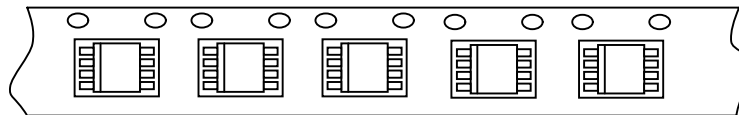
**Note:** A<sub>0</sub> B<sub>0</sub> K<sub>0</sub> are determined by component size. The clearance between the component and the cavity must be within 0.05 [.002] min. to 0.50 [.020] max. for 8mm tape, 0.05 [.002] min to 0.65 [.026] max for 12mm tape.



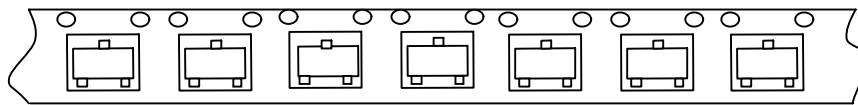
REEL DIMENSIONS							
Tape Size	A Max.	B Min.	C	D* Min.	N Min.	G	T Max.
8mm	330 (12.992)	1.5 (.059)	13.0±0.20 (.152±.008)	20.2 (.795)	50 (1.973)	8.4±1.5 0.0 (.331±.059) 0.0	14.4 (.567)
12mm	330 (12.992)	1.5 (.059)	13.0±0.20 (.152±.008)	20.2 (.795)	50 (1.973)	12.4±2.0 0.0 (.488±.078) 0.0	14.4 (.567)

MECHANICAL POLARIZATION

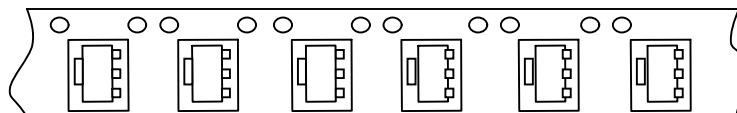
SOIC DEVICES



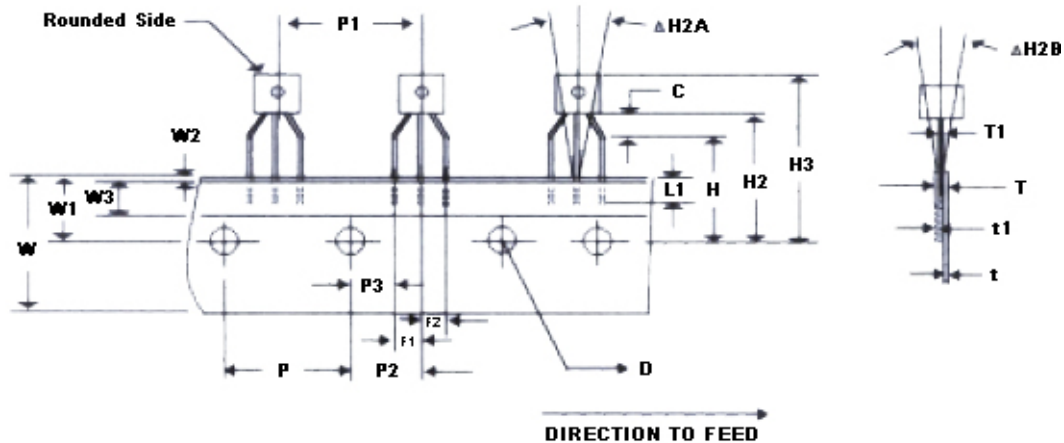
SOT 23 3L DEVICE



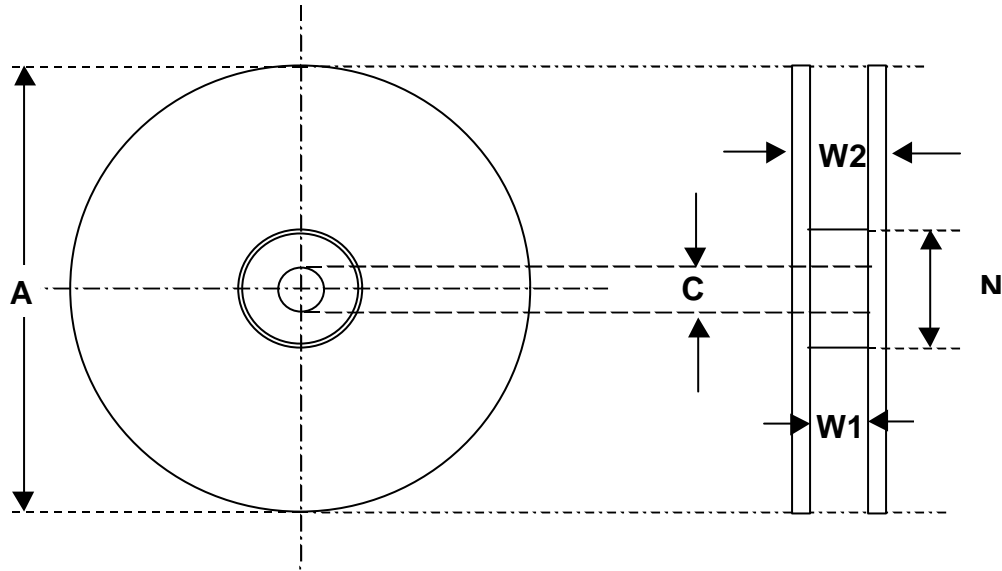
SOT 89 DEVICE



## TO-92 Tape &amp; Reel &amp; Ammo Pack Specifications



SYM	DESCRIPTION	NOMINAL		TOLERANCES			
		VALUE		min		max	
BOL		mm	inch	mm	inch	mm	inch
D	Feed Hole Diameter	4.0	0.157	3.8	0.150	4.2	0.165
T1 (POD)	Component Lead Thickness	0.405	0.016	0.36	0.014	0.45	0.018
F1/F2	Lead Pitch ( Left / Right)	2.54	0.100	2.4	0.094	2.8	0.110
C	Bottom of Component to Seating Plane	2.50	0.098	1.50	0.059	4.00	0.157
W1	Edge to Sprocket Hole Center	9.0	0.354	8.50	0.335	9.50	0.374
H2A	Deflection (Left or Right)	0.50	0.020	0	0	0.50	0.020
H2B	Deflection (Front or Rear)	1.0	0.039	0	0	1.0	0.039
H2 (H +C)	Feed Hole to Bottom of Component	18.5	0.728	17.00	0.669	20.50	0.087
H	Height of Seating Plane	16	0.630	15.5	0.610	16.5	0.650
H3	Feed Hole Center to Overall Transistor Height	27.75	1.092	23.5	0.925	32.0	1.260
L	Defective Unit Clipped Dimension	-	-	-	-	11.0	0.433
L1	Leadwire Enclosure	2.50	0.098	2.50	0.098	-	-
P	Feed Hole Pitch	12.7	0.500	12.40	0.488	13.0	0.512
P2	Center of Feed Hole to Center Lead	6.35	0.250	6.0	0.234	6.75	0.266
P3 (P2-F1)	First Lead Spacing Dimension	3.75	0.148	3.6	0.142	3.95	0.156
P1	Center Lead to Center Lead	12.7	0.500	12.2	0.500	13.2	0.520
t1	Adhesive Tape Thickness	0.18	0.007	0.16	0.006	0.20	0.008
T (t+t1+T1)	Overall Taped Package Thickness	-	-	-	-	1.55	0.061
t	Carrier Strip Thickness	0.37	0.015	0.27	0.011	0.47	0.018
W	Carrier Strip Width (18mm)	18.00	0.709	17.5	0.689	19.0	0.748
W3	Adhesive Tape Width (6mm)	6.00	0.236	5.5	0.217	6.3	0.248
W2	Adhesive Tape Position	0.25	0.010	0	0	0.50	0.020



REEL DIMENSIONS		
SYMBOL	DESCRIPTION	DIMENSION
A	Reel Diameter	178-370mm
C	Arbor Hole Diameter	14-38mm
N	Hub Diameter	80mm, maximum
W1	Dimension between the flanges (measured @ hub)	1.5 to 8.0mm > C
W2	Width including flanges and hubs	56mm, maximum

TO-92 Reel Requirement					
Components		Tape Width (W) mm	Device Per reel		
			7" Reel	13" Reel	14" Reel
TO-92	3L	18	-	-	2000

TO-92 Ammo Pack Requirement			
Components		Tape Width (W) mm	Fan Fold Box
TO-92	3L	18	2000

**Notes**