

## Description

The Bay Linear B431 is a three terminal adjustable shunt regulator with thermal stability over Temperature range. Using two external resistors allows the output voltage to be adjusted from 2.5V to 36V. With a sharp turn on characteristics the B431 a superior replacement for zener diode applications.

The B431 shunt regulator has a tolerance of 0.5% which has proven to be sufficient to overcome all of the other errors in the system to virtually eliminate the need for trimming in the power supply manufacturers assembly line and contribute a significant cost savings.

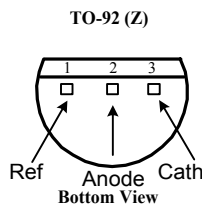
## Features

- **Wide Operating Range ...1mA to100mA**
- **Tight Band Gap Tolerance ..... 0.5%**
- **Low Temp. Coefficient.....30 ppm/°C**
- **Wide temp range of -40 to +105°C**
- **Available in TO92, SOT-89, SO-8**

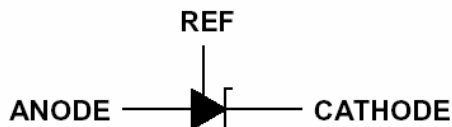
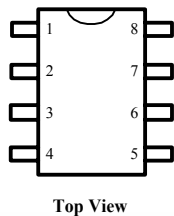
## Applications

- **Switching Power Supplies**
- **Adjustable Power Supplies**
- **Linear Regulators**
- **Battery Powered Equipment**
- **Monitors, TV, VCR**
- **Instrumentation**

## Package Information



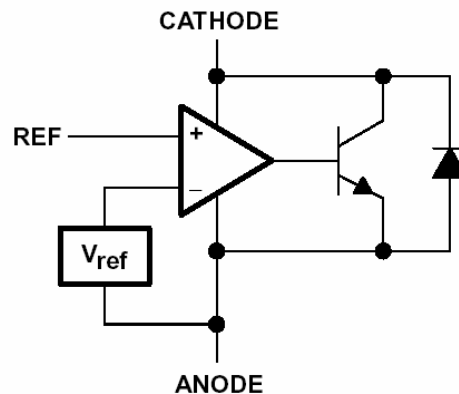
8-Pin Surface Mount (M)



## Ordering Information

Package	Tolerance			
	0.5%	1%	1%	2%
TO-92	B431AZ	B431BZ	B431DBZ	B431CZ
SOT-89	B431AR	B431BR	B431DBR	B431CR
8SOIC	B431AM	B431BM	B431DBM	B431CM

The Electrical Grade & Type is specified on shipping Box Only



## Absolute Max Ratings

Parameter	Symbol	Maximum	Units
Cathode Voltage	$V_Z$	37	V
Continuous Cathode Current	$I_Z$	150	mA
Reference Input Current	$I_{REF}$	10	mA
Power Dissipation at $T_A = 25^\circ\text{C}$			
SOT-89	$P_D$	1000	mW
S0-8		750	
TO-92		775	
Thermal Resistance			
S0-8	$\theta_{JA}$	175	$^\circ\text{C}/\text{W}$
TO-92		160	
SOT-89		110	
Operating Junction Temperature Range	$T_J$	-40 to +150	$^\circ\text{C}$
Operating Ambient Temperature	$T_A$	-40 to +105	$^\circ\text{C}$
Storage Temperature Range	$T_{STG}$	-65 to +150	$^\circ\text{C}$
Lead Temperature (Soldering) 10 seconds	$T_{LEAD}$	300	$^\circ\text{C}$
ESD Rating (Human Body Model)	$T_{ESD}$	2	kV

## Recommended Operating Conditions

	Min	Max	Symbol
Cathode Voltage, $V_Z$	$V_{REF}$	36	V
Cathode Current, $I_Z$	0.1	100	mA

## Electrical Characteristics

Unless specified:  $T_A = 25^\circ\text{C}$ . Values in bold apply over full operating ambient temperature.

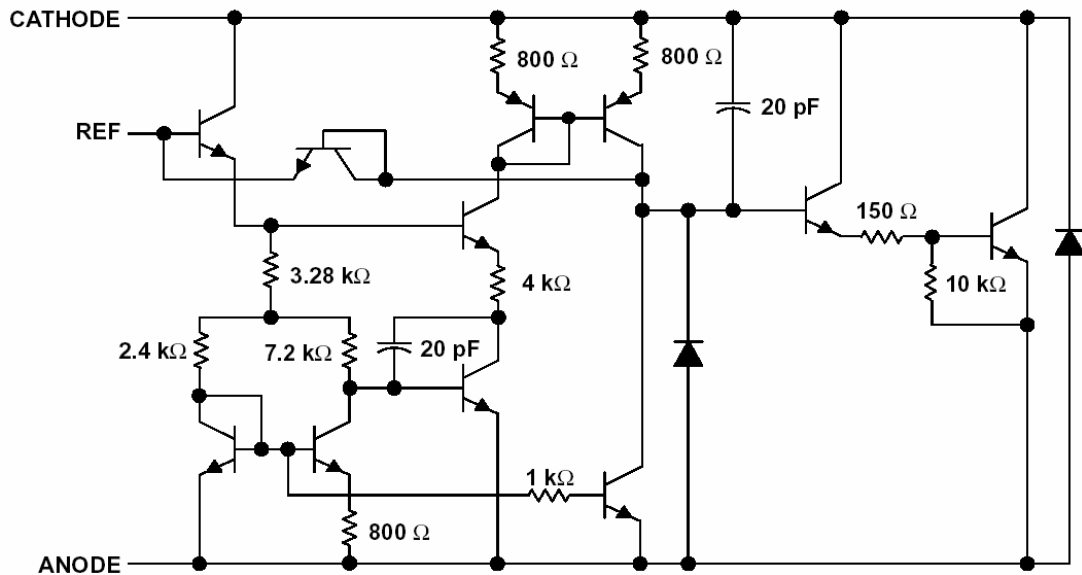
			B431 0.5%			
Parameter	Symbol	Condition	Min	Typ	Max	Units
Reference Voltage	$V_{REF}$	$V_Z = V_{REF1}$ , $I_Z = 10\text{mA}^{(1)}$	2.483	2.495	2.507	V
$V_{REF}$ Temp Deviation	$V_{DEV}$	$V_Z = V_{REF1}$ , $I_Z = 10\text{mA}^{(1)}$		4	17	mV
Ratio of Change in $V_{REF}$ To Change in $V_Z$	$\frac{\Delta V_{REF}}{\Delta V_Z}$	$I_Z = 10\text{mA}, \Delta V_Z = 10\text{V to } V_{REF}$		-1.0	-2.7	mV/V
		$I_Z = 10\text{mA}, \Delta V_Z = 36\text{V to } 10\text{V}$		-0.4	-2.0	
Reference Input Current	$I_{REF}$	$R1 = 10\text{k}\Omega$ , $R2 = \infty$ , $I_Z = 10\text{mA}^{(2)}$		0.7	4	$\mu\text{A}$
$I_{REF}$ Temperature Deviation	$I_{REF(DEV)}$	$R1 = 10\text{k}\Omega$ , $R2 = \infty$ , $I_Z = 10\text{mA}^{(2)}$		0.4	1.2	$\mu\text{A}$
Off-State Cathode Current	$I_{Z(OFF)}$	$V_{REF} = 0\text{V}$ , $V_Z = 36\text{V}^{(3)}$		0.1	1	$\mu\text{A}$
Dynamic Output Impedance	$r_Z$	$F < 1\text{kHz}$ , $V_Z = V_{REF}$ , $I_Z = 1\text{mA to } 100\text{mA}^{(1)}$		0.20	0.50	$\Omega$
Minimum Operating Current	$I_{Z(MIN)}$	$V_Z = V_{REF}^{(1)}$		0.4	1	mA

			B431 1%			
Parameter	Symbol	Condition	Min	Typ	Max	Units
Reference Voltage	$V_{REF}$	$V_Z = V_{REF1} I_Z = 10mA^{(1)}$	2.470	2.495	2.520	V
$V_{REF}$ Temp Deviation	$V_{DEV}$	$V_Z = V_{REF1} I_Z = 10mA^{(1)}$		4	17	mV
Ratio of Change in $V_{REF}$ To Change in $V_Z$	$\frac{\Delta V_{REF}}{\Delta V_Z}$	$I_Z = 10mA, \Delta V_Z = 10V$ to $V_{Ref}$		-1.0	-2.7	mV/V
		$I_Z = 10mA, \Delta V_Z = 36V$ to $10V$		-0.4	-2.0	
Reference Input Current	$I_{REF}$	$R1 = 10k\Omega, R2 = \infty,$ $I_Z = 10mA^{(2)}$		0.7	4	$\mu A$
$I_{REF}$ Temperature Deviation	$I_{REF(DEV)}$	$R1 = 10k\Omega, R2 = \infty,$ $I_Z = 10mA^{(2)}$		0.4	1.2	$\mu A$
Off-State Cathode Current	$I_{Z(OFF)}$	$V_{REF} = 0V, V_Z = 36V^{(3)}$		0.1	1	$\mu A$
Dynamic Output Impedance	$r_Z$	$F < 1kHz, V_Z = V_{REF}$ $I_Z = 1mA$ to $100mA^{(1)}$		0.20	0.50	$\Omega$
Minimum Operating Current	$I_{Z(MIN)}$	$V_Z = V_{REF}^{(1)}$		0.4	1	mA

			B431 2%			
Parameter	Symbol	Condition	Min	Typ	Max	Units
Reference Voltage	$V_{REF}$	$V_Z = V_{REF1} I_Z = 10mA^{(1)}$	2.445	2.495	2.545	V
$V_{REF}$ Temp Deviation	$V_{DEV}$	$V_Z = V_{REF1} I_Z = 10mA^{(1)}$		4	17	mV
Ratio of Change in $V_{REF}$ To Change in $V_Z$	$\frac{\Delta V_{REF}}{\Delta V_Z}$	$I_Z = 10mA, \Delta V_Z = 10V$ to $V_{Ref}$		-1.0	-2.7	mV/V
		$I_Z = 10mA, \Delta V_Z = 36V$ to $10V$		-0.4	-2.0	
Reference Input Current	$I_{REF}$	$R1 = 10k\Omega, R2 = \infty,$ $I_Z = 10mA^{(2)}$		0.7	4	$\mu A$
$I_{REF}$ Temperature Deviation	$I_{REF(DEV)}$	$R1 = 10k\Omega, R2 = \infty,$ $I_Z = 10mA^{(2)}$		0.4	1.2	$\mu A$
Off-State Cathode Current	$I_{Z(OFF)}$	$V_{REF} = 0V, V_Z = 36V^{(3)}$		0.1	1	$\mu A$
Dynamic Output Impedance	$r_Z$	$F < 1kHz, V_Z = V_{REF}$ $I_Z = 1mA$ to $100mA^{(1)}$		0.20	0.50	$\Omega$
Minimum Operating Current	$I_{Z(MIN)}$	$V_Z = V_{REF}^{(1)}$		0.4	1	mA

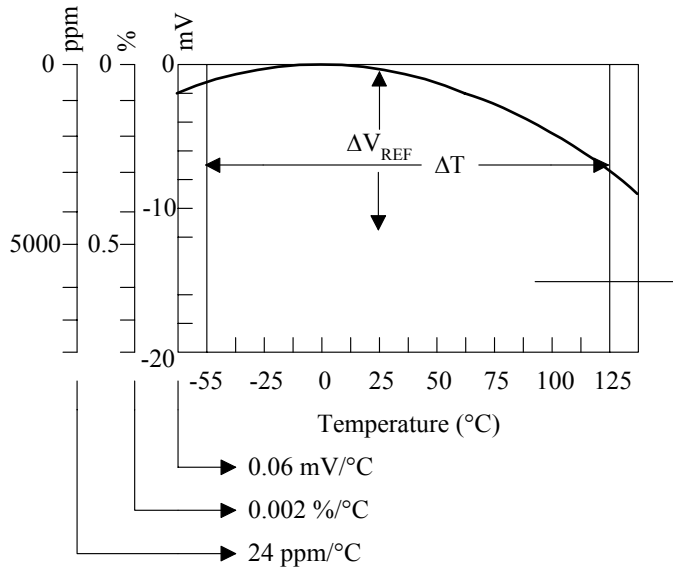
Parameter	Symbol	Condition	B431D 1%			Units
			Min	Typ	Max	
Reference Voltage	$V_{REF}$	$V_Z = V_{REF1} I_Z = 10mA^{(1)}$	2.470	2.495	2.520	V
$V_{REF}$ Temp Deviation	$V_{DEV}$	$V_Z = V_{REF1} I_Z = 10mA^{(1)}$		4	17	mV
Ratio of Change in $V_{REF}$ To Change in $V_Z$	$\frac{\Delta V_{REF}}{\Delta V_Z}$	$I_Z = 10mA, \Delta V_Z = 10V \text{ to } V_{Ref}$		-1.0	-2.7	mV/V
		$I_Z = 10mA, \Delta V_Z = 36V \text{ to } 10V$		-0.4	-2.0	
Reference Input Current	$I_{REF}$	$R1 = 10k\Omega, R2 = \infty, I_Z = 10mA^{(2)}$		0.7	4	$\mu A$
$I_{REF}$ Temperature Deviation	$I_{REF(DEV)}$	$R1 = 10k\Omega, R2 = \infty, I_Z = 10mA^{(2)}$		0.4	1.2	$\mu A$
Off-State Cathode Current	$I_{Z(OFF)}$	$V_{REF} = 0V, V_Z = 36V^{(3)}$		0.1	1	$\mu A$
Dynamic Output Impedance	$r_Z$	$F < 1kHz, V_Z = V_{REF}, I_Z = 1mA \text{ to } 100mA^{(1)}$		0.20	0.50	$\Omega$
Minimum Operating Current	$I_{Z(MIN)}$	$V_Z = V_{REF}^{(1)}$		0.4	1	mA

Note 1: B431D is rated at -40°C to +85°C and 50ppm/°C



† All component values are nominal.

### Calculating Average Temperature Coefficient (TC)



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

### Test Circuit

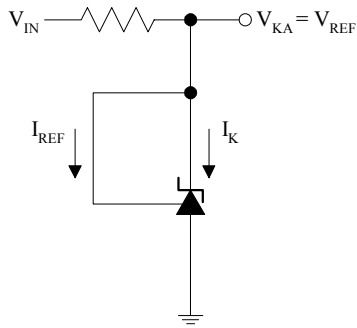


Figure 1a. Test Circuit 1

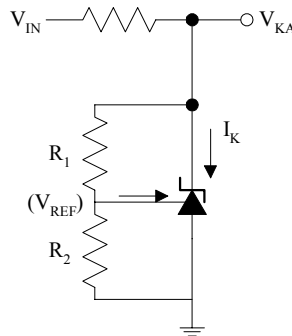


Figure 1b. Test Circuit 2

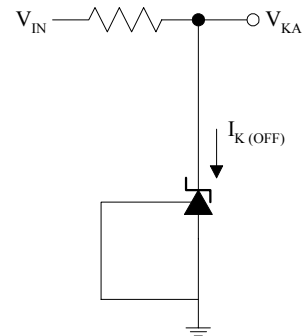


Figure 1c. Test Circuit 3

TYPICAL PERFORMANCE CURVES

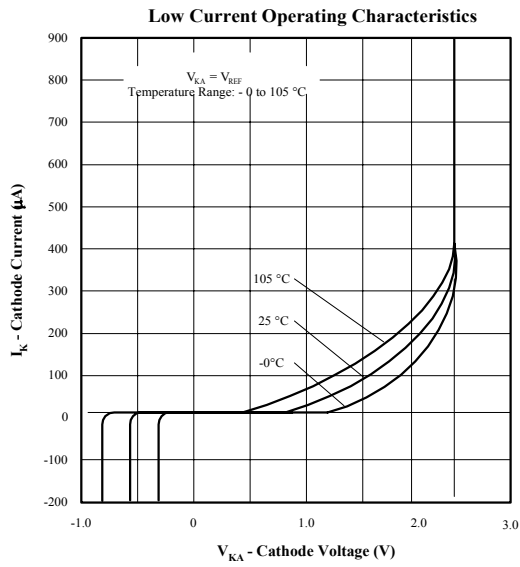


Figure 2

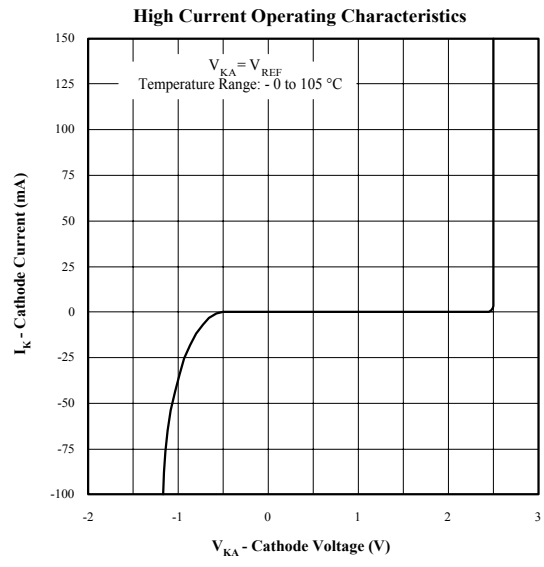


Figure 3

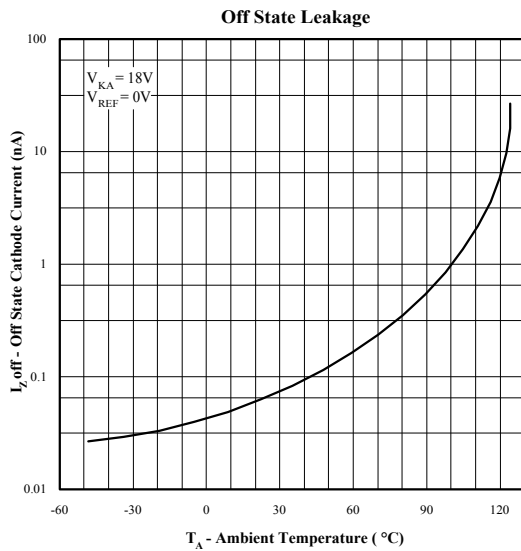


Figure 4

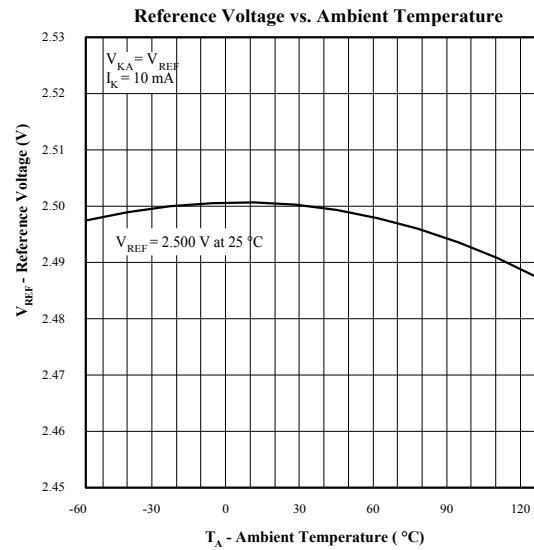


Figure 5

TYPICAL PERFORMANCE CURVES

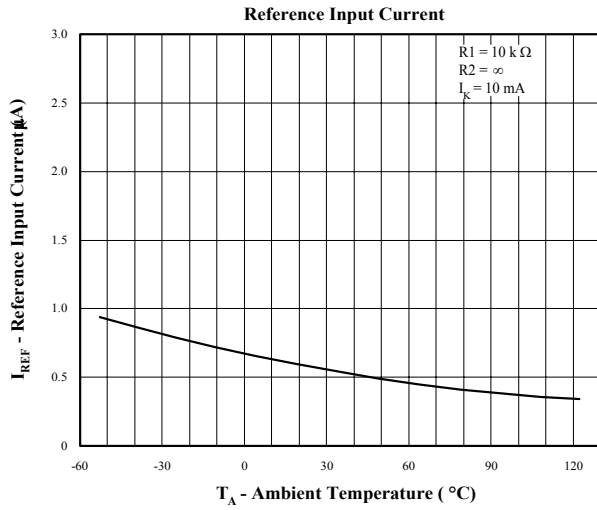


Figure 6

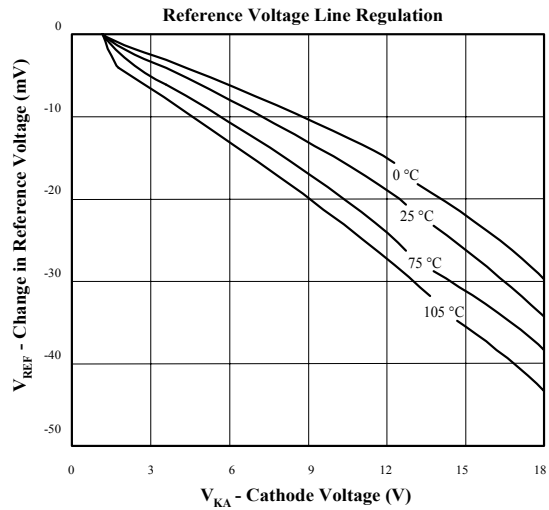


Figure 7

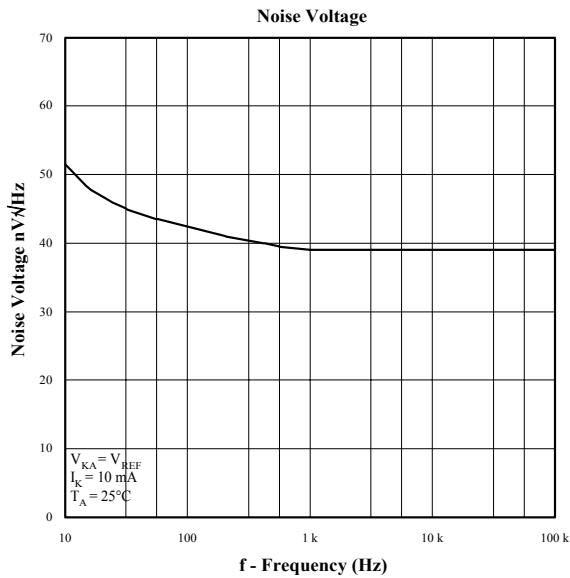


Figure 8

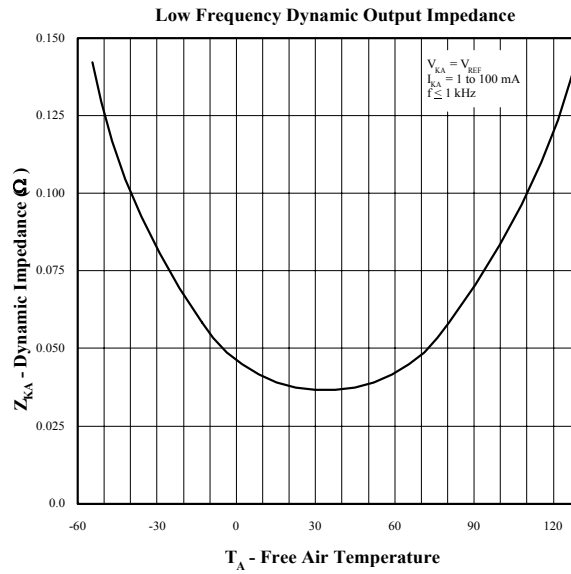


Figure 9

TYPICAL PERFORMANCE CURVES

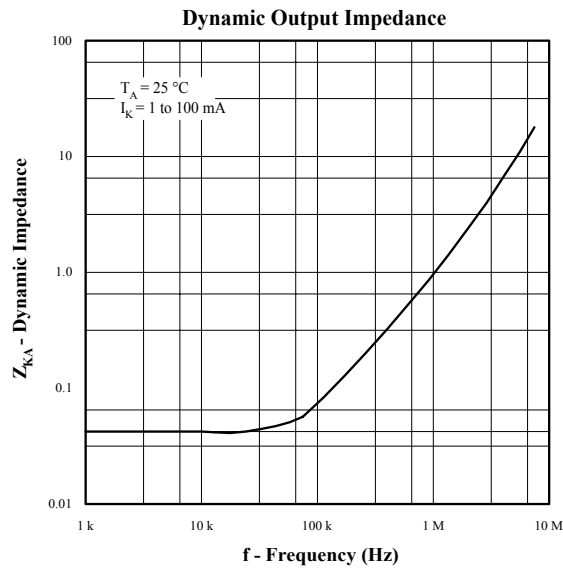


Figure 10

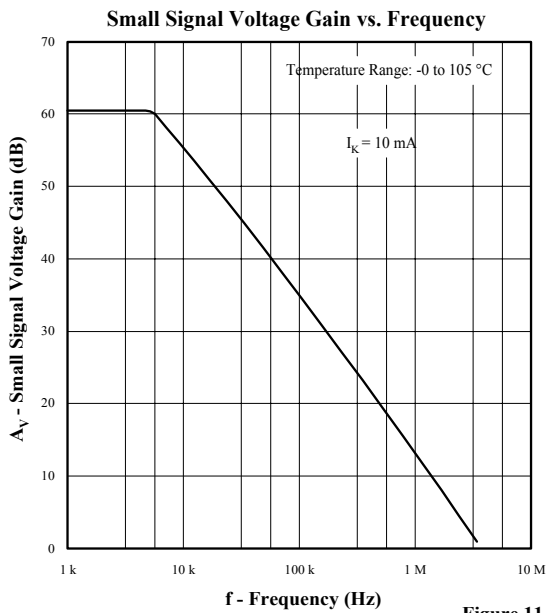
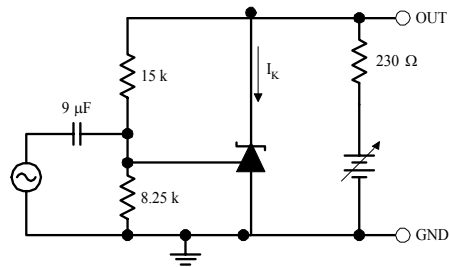


Figure 11





TYPICAL PERFORMANCE CURVES

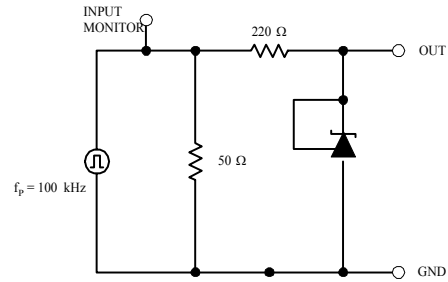
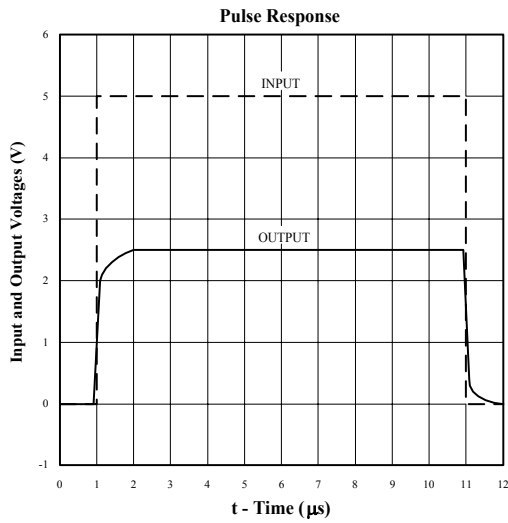


Figure 12

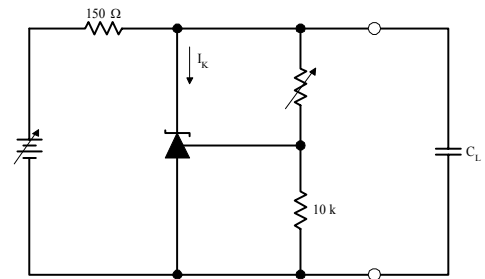
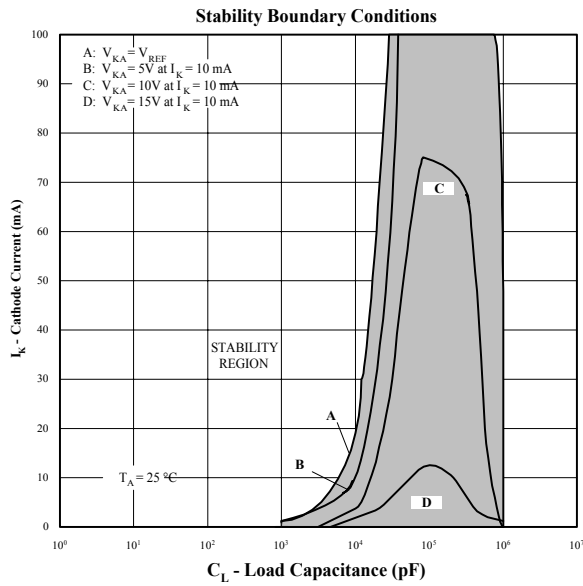
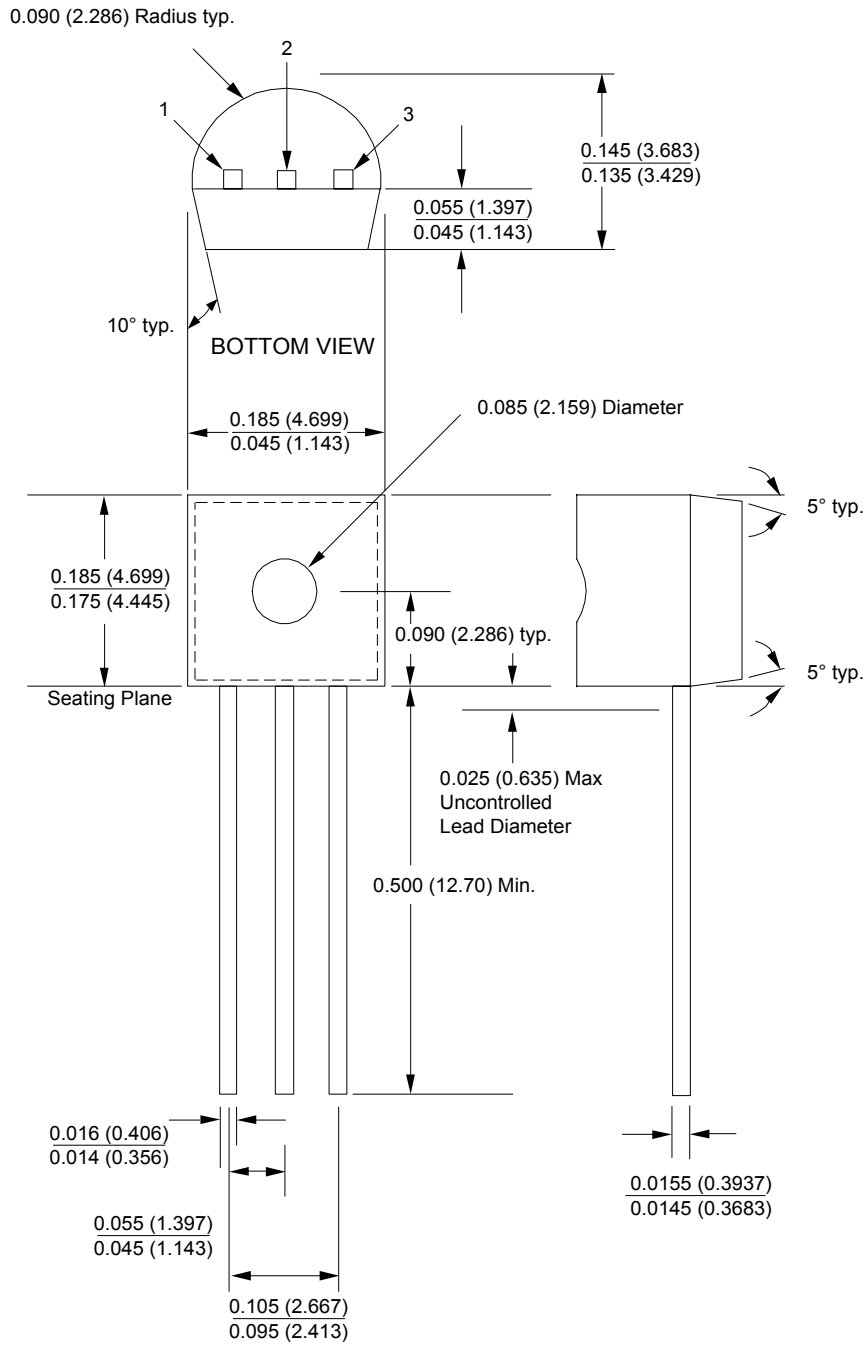
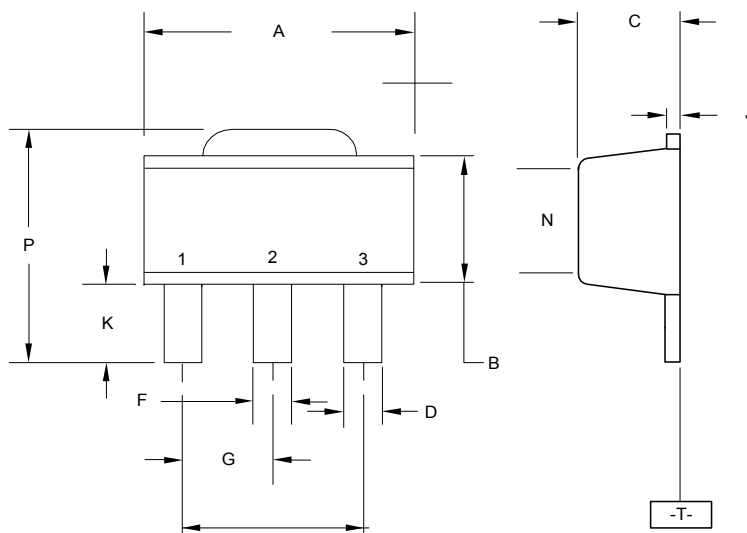


Figure 13

TO-92



SOT-89



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.40	4.60	0.174	0.181
B	2.29	2.60	0.091	0.102
C	140	160	0.056	0.062
D	0.36	0.48	0.015	0.018
E	1.62	1.80	0.064	0.070
F	0.44	0.53	0.018	0.020
G	150 BSC		0.059 BSC	
J	0.35	0.44	0.014	0.017
K	0.80	1.04	0.032	0.040
L	300 BSC		0.118 BSC	
N	2.04	2.28	0.081	0.089
P	3.94	4.25	0.156	0.167

**Advance Information-** These data sheets contain descriptions of products that are in development. The specifications are based on the engineering calculations, computer simulations and/ or initial prototype evaluation.

**Preliminary Information-** These data sheets contain minimum and maximum specifications that are based on the initial device characterizations. These limits are subject to change upon the completion of the full characterization over the specified temperature and supply voltage ranges.

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