



# CAT431L

## Low-Voltage Adjustable Precision Voltage Reference

- 0.5% Tolerance

- SOT23 and TO92 Packages

- Low Startup Overshoot

### FEATURES

- Low startup overshoot
- Wide current operation: 40 $\mu$ A to 100mA
- Low temperature coefficient reference:  $\pm 12$ mV max deviation over temperature
- Accurate 1.24V reference voltage:  $\pm 0.5\%$  ( $\pm 6$ mV) at 25°C
- Low dynamic impedance: 0.3 $\Omega$  at 1kHz
- Compact 3-lead SOT23 package option
- Industrial temperature range: -40°C to 85°C
- Adjustable output voltage:  $V_{REF}$  to 6V

### APPLICATIONS

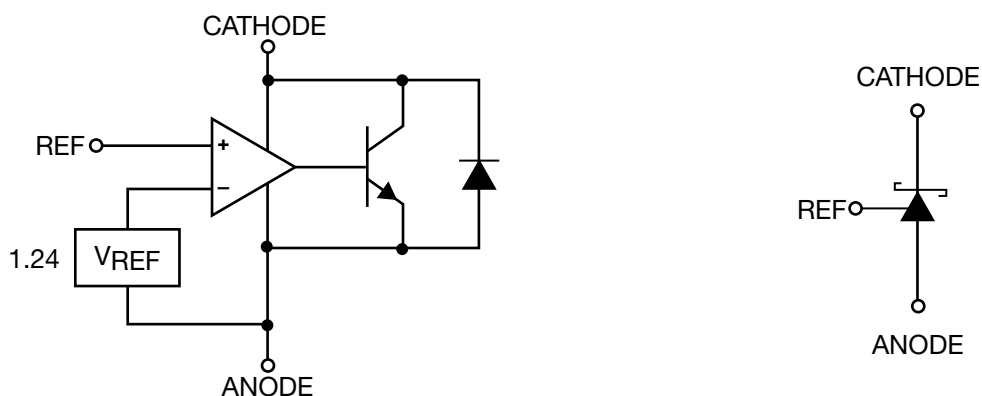
- SMPS control loop
- Shunt regulator
- Low temperature coefficient voltage reference
- Current limiting
- Over/Under voltage monitor
- 3V Off-line switching regulators

### DESCRIPTION

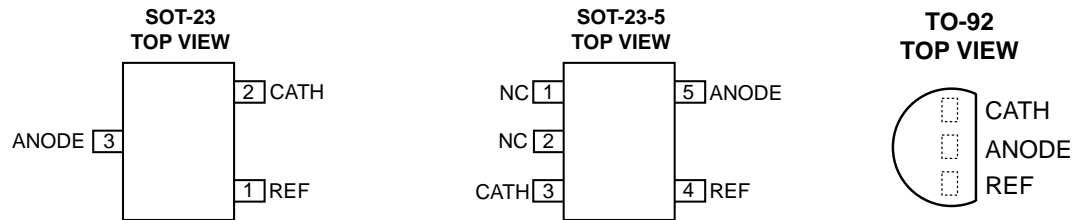
The CAT431L is a low-voltage three-terminal adjustable shunt voltage reference with guaranteed thermal stability over the industrial temperature range. The CAT431L has a lower 1.24V reference and wider operating current range than the widely used TL431 and TL431A shunt-regulator references. Compared to the TLV431/A, the CAT431L 1.24V reference is two times more accurate.

Minimal overshoot at startup and wide AC bandwidth make the CAT431L easy to apply in a wide set of applications. When used with an opto-coupler, the CAT431L is an ideal voltage reference in isolated feedback circuits for 3V to 3.3V switch-mode power supplies.

### FUNCTIONAL DIAGRAM



PIN CONFIGURATION



PIN DESCRIPTIONS

Pin Name	Function
CATH	Output and supply terminal, must be greater than 1.24V for normal operation
REF	Input, nominally 1.24V in normal operation
ANODE	Ground and Substrate

ORDERING INFORMATION

Part Number	Package	Ambient Temperature Range
CAT431LEUR-TE7	3-Pin, SOT-23	-40° C to 85° C
CAT431LEUK-TE7	5-Pin, SOT-23	-40° C to 85° C
CAT431LEZR-TEAP	3-Pin, TO-92	-40° C to 85° C

TE7 = 7" Reel, 3,000 parts per reel  
TEAP = Ammopack, 3,000 parts per reel

## ABSOLUTE MAXIMUM RATINGS

Cathode Voltage ..... 18V  
 REF Current ..... 3mA  
 Cathode, Anode Currents ..... 150mA  
 Operating Junction Temperature ..... 150°C  
 Lead Soldering Temperature (10 sec) ..... 260°C  
 Storage Temperature Range ..... -65°C to +150°C

These are stress ratings only and functional operation is not implied. Exposure to absolute maximum ratings for prolonged time periods may affect device reliability. All voltages are with respect to ground.

## ELECTRICAL CHARACTERISTICS

Electrical characteristics are guaranteed over the full operating temperature range of -40°C to +85°C with a junction temperature from -40°C to +105°C unless otherwise specified. Ambient temperature must be de-rated based upon power dissipation and package thermal characteristics.<sup>1</sup>

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V <sub>REF</sub>	Reference Voltage	V <sub>REF</sub> =V <sub>CATH</sub>	25° C	1.234	1.240	1.246	V
		I <sub>CATH</sub> =10mA	TEMP	1.228	1.240	1.252	V
ΔV <sub>REF</sub>	VREF Temperature deviation				4	12	mV
$\frac{\Delta V_{REF}}{\Delta V_{CATH}}$	Ratio of V <sub>REF</sub> Change to V <sub>CATH</sub> Change (Line Reg; 1/gain)	I <sub>CATH</sub> =10mA V <sub>CATH</sub> =V <sub>REF</sub> to 6V			0.3	1	mV/V
I <sub>REF</sub>	Reference input current	I <sub>CATH</sub> =10mA			0.2	0.4	μA
ΔI <sub>REF</sub>	I <sub>REF</sub> Temperature Deviation				0.04	0.2	μA
I <sub>CATH(min)</sub>	Minimum Cathode Current				18	40	μA
I <sub>CATH(OFF)</sub>	Off-State Cathode Current	V <sub>REF</sub> =0V; V <sub>CATH</sub> =16V				100	nA
r <sub>CATH</sub>	Dynamic Output Impedance	I <sub>CATH</sub> =0.1 to 100mA f=1.0kHz			0.3	0.4	Ω

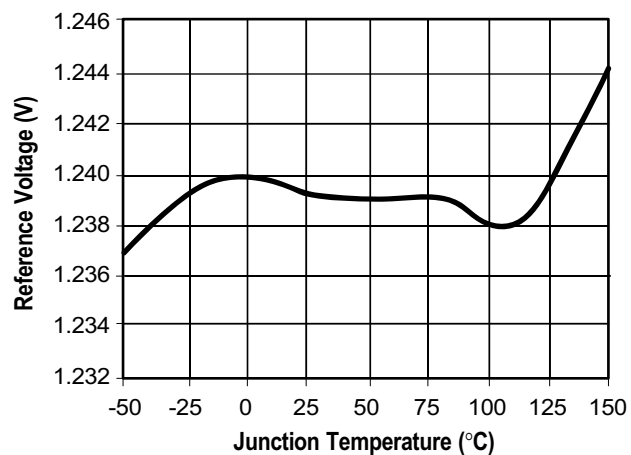
1. Thermal Characteristics ( $\theta_{JA}$ )  
 3-lead, SOT-23: 336°C/W  
 5-lead, SOT-23: 255  
 3-pin, TO-92: 155

## Recommended Operating Conditions

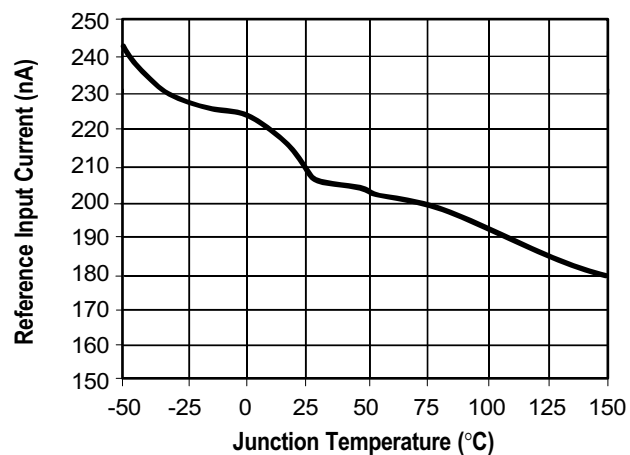
Parameter	Min	Max	Units
Cathode Voltage	VREF	6	V
Cathode Current	0.1	15	mA
Operating Ambient Temperature	-40	85	°C

## TYPICAL PERFORMANCE CHARACTERISTICS

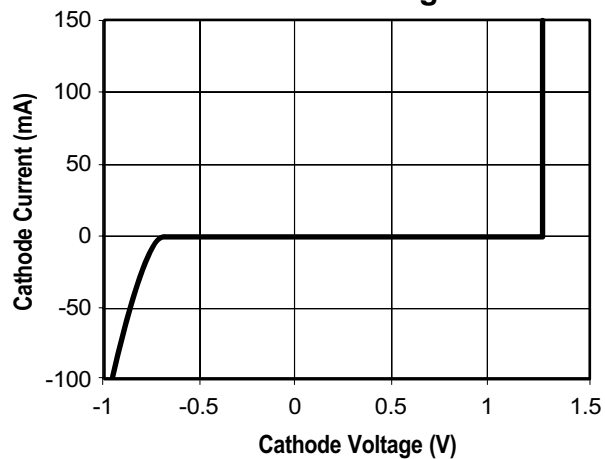
**Reference Voltage  
vs.  
Junction Temperature**



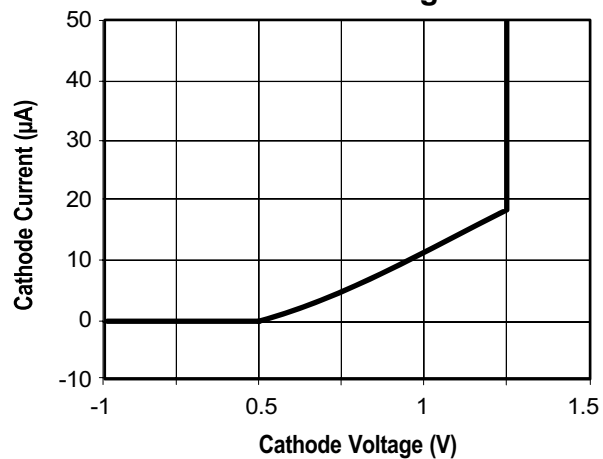
**Reference Input Current  
vs.  
Junction Temperature**



**Cathode Current  
vs.  
Cathode Voltage**

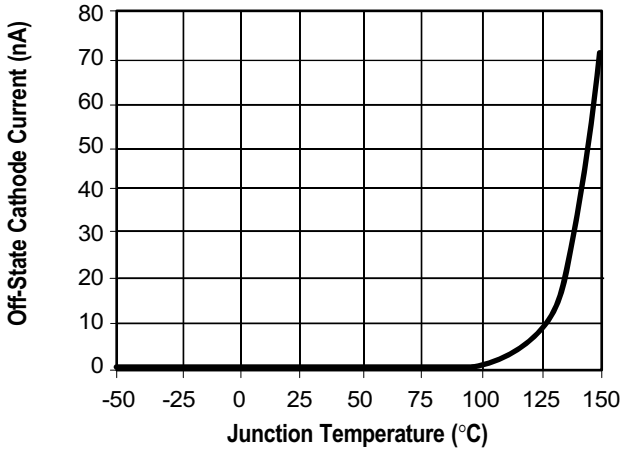


**Cathode Current  
vs.  
Cathode Voltage**

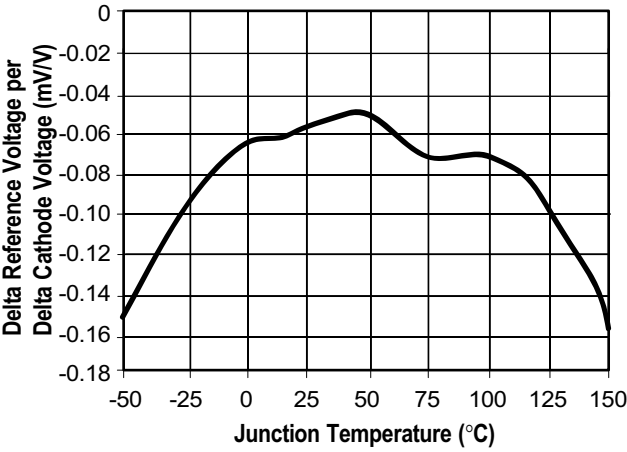


TYPICAL PERFORMANCE CHARACTERISTICS

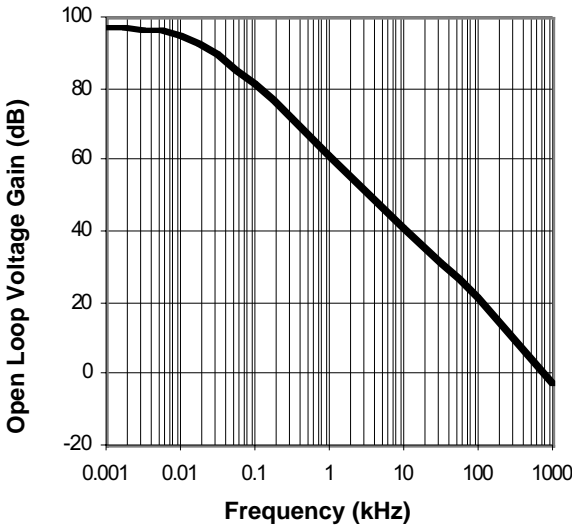
Off-State Cathode Current  
vs.  
Junction Temperature



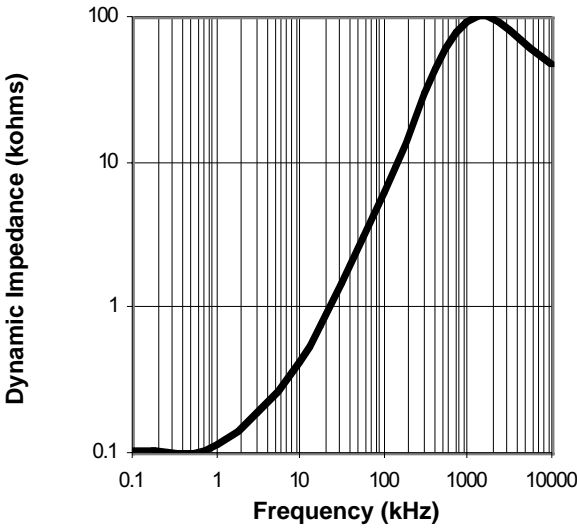
Delta Reference Voltage Per  
Delta Cathode Voltage vs.  
Junction Temperature



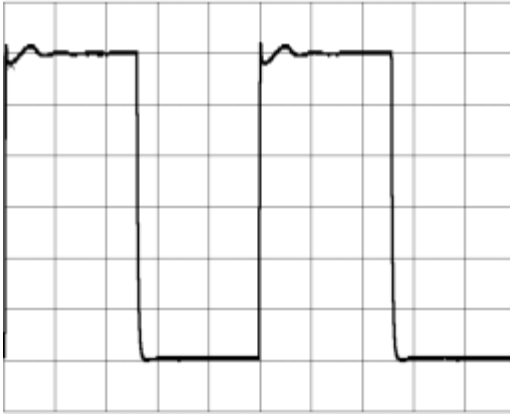
Open Loop Voltage Gain  
vs.  
Frequency



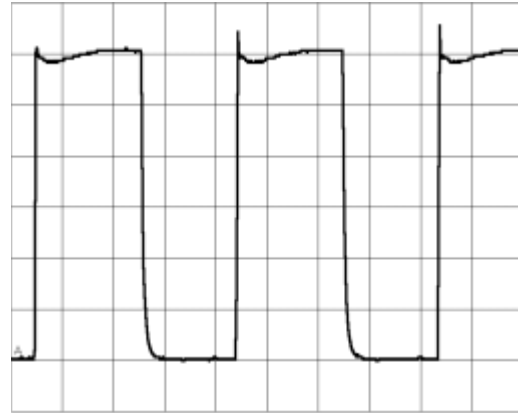
Dynamic Impedance  
vs.  
Frequency



**Pulse Response, 100 $\mu$ A**  
(200mV/div, 2 $\mu$ s/div)

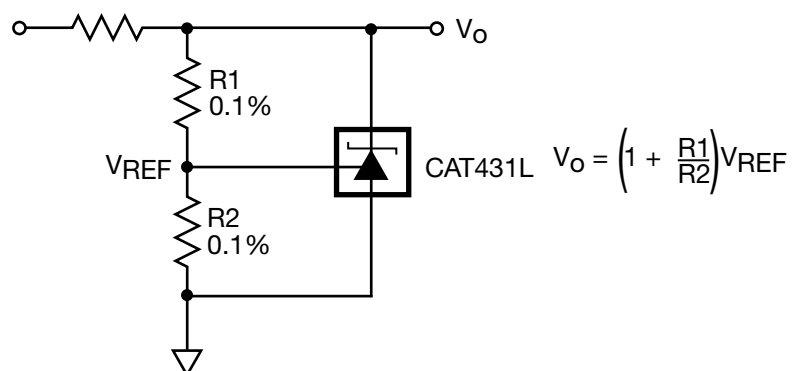


**Pulse Response, 1mA**  
(200mV/div, 2 $\mu$ s/div)

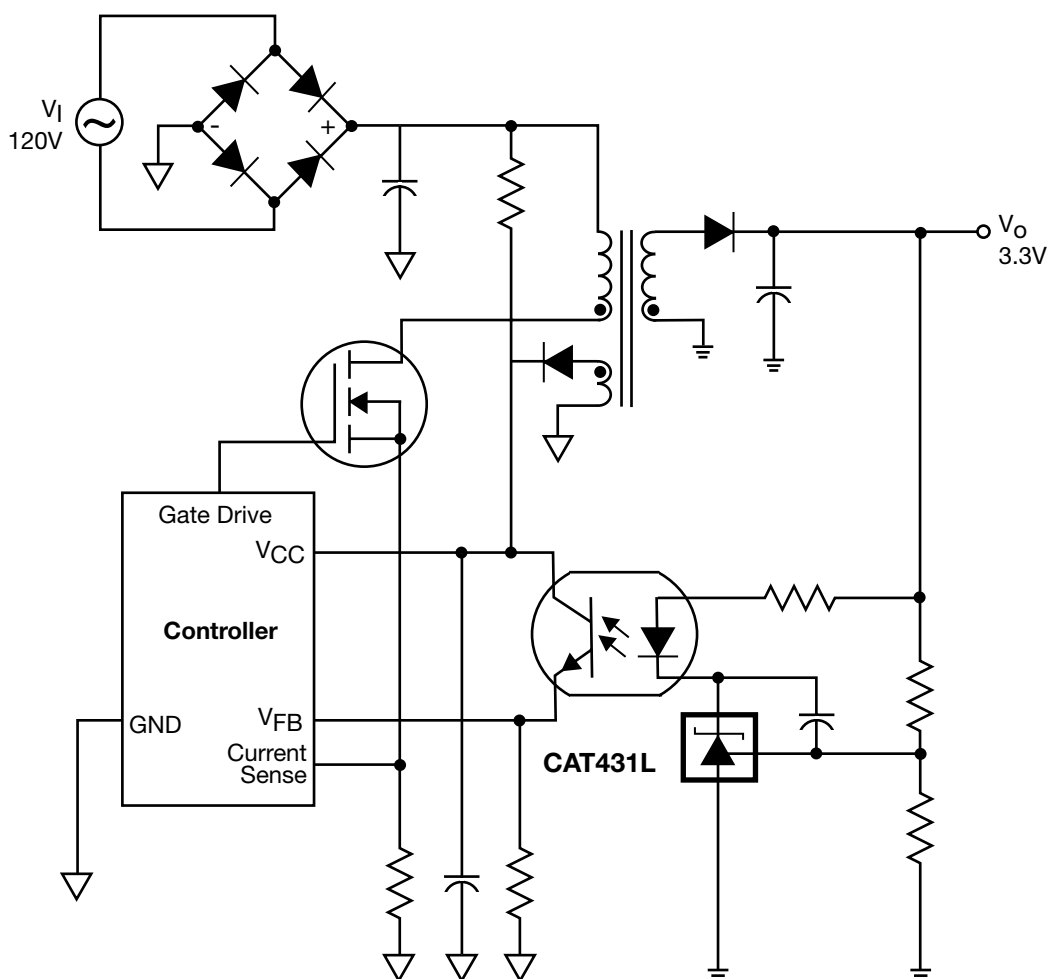


## TYPICAL APPLICATIONS

### Shunt Voltage Regulator

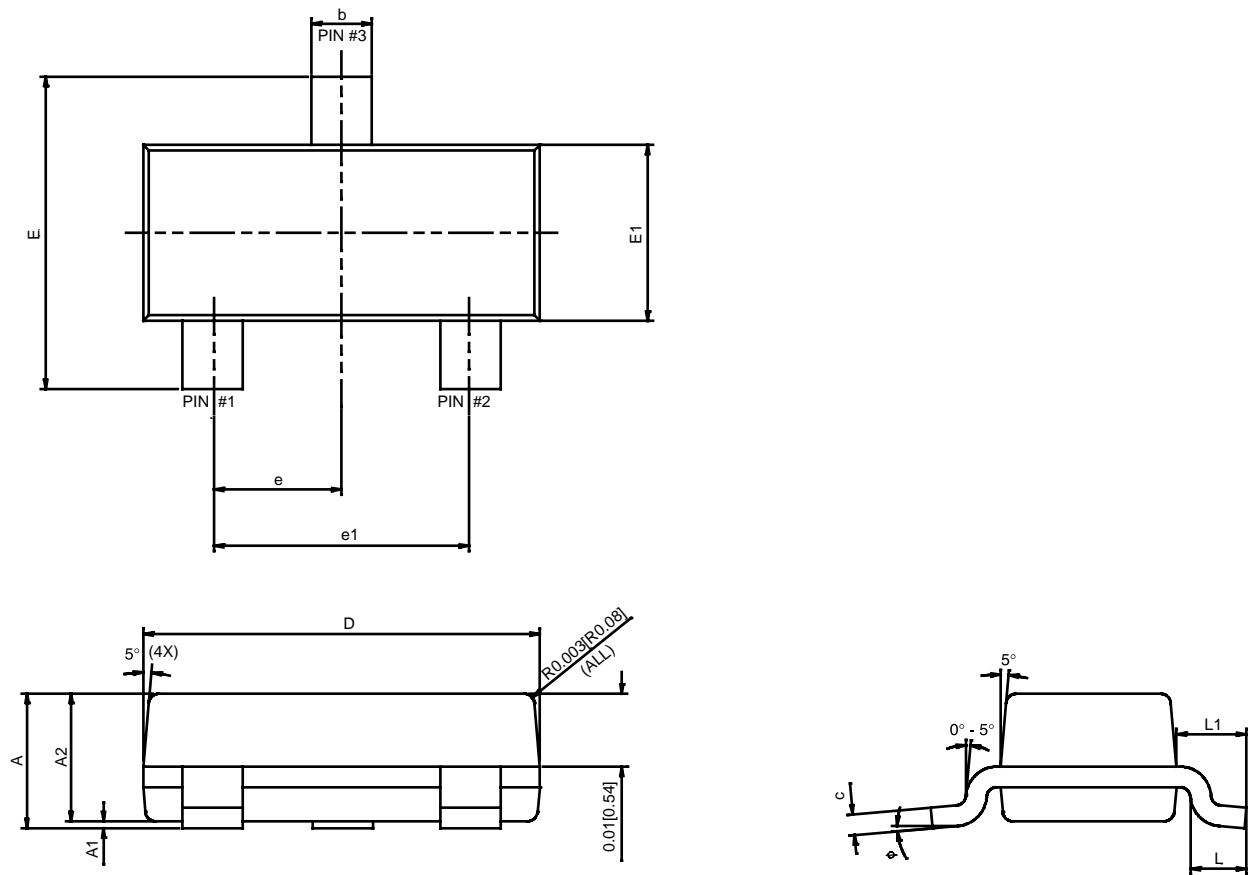


### Flyback Converter with Optical Isolation



PACKAGE OUTLINES

3 LEAD SOT-23

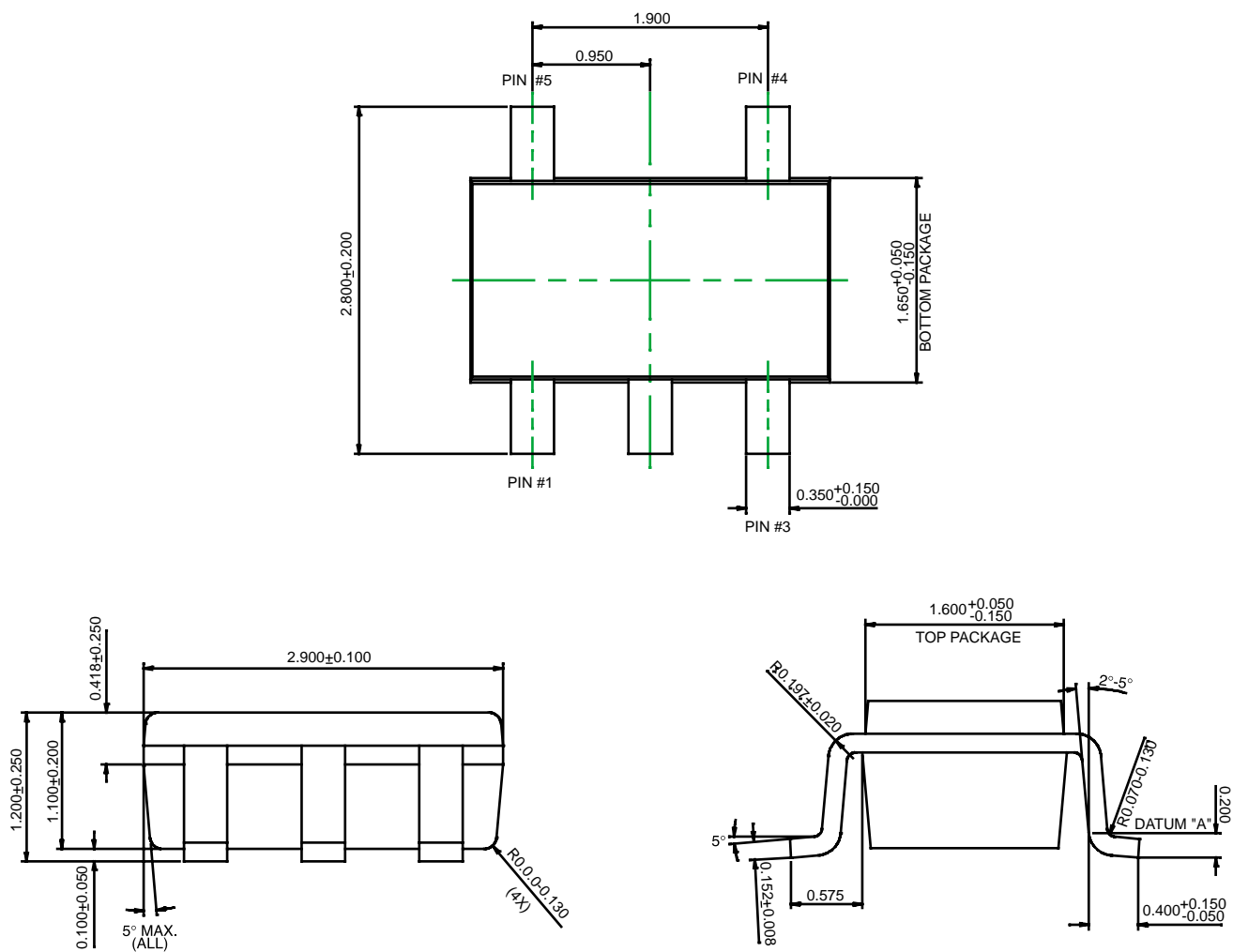


- NOTES:
1. ALL DIMENSIONS ARE IN INCHES & IN [ ] ARE IN MM.
  2. PACKAGE OUTLINE DIMENSIONS INCLUSIVE OF METAL BURRS.
  3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.076MM. [0.003"].
  4. ALL PACKAGE SURFACES TO BE MIRROR FINISH.
  5. MOLDING AND FORMING WITH DIE FACING UP.
  6. LEADFINISH PLATING: 0.00762MM [0.0003"] - 0.0254MM [0.001"]. PACKAGE OUTLINE EXCLUSIVE OF LEADFINISH PLATING.
  7. THIS POD COMPLIES TO JEDEC TO-236AB ISSUE H.

DIM	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	.0350	.0429	0.89	1.09
A1	.0008	.0031	0.02	0.08
A2	.0346	.0394	0.88	1.00
b	.0150	.0197	0.38	0.50
c	.0055	.0063	0.14	0.16
D	.1102	.1197	2.80	3.04
e	.0354	.0394	0.90	1.00
e1	.0709	.0787	1.80	2.00
E	.0827	.0984	2.10	2.50
E1	.0472	.0551	1.20	1.40
L	.0157	.0217	0.40	0.55
L1	.0177	.0236	0.45	0.60
⌀	0°	5°	0°	5°

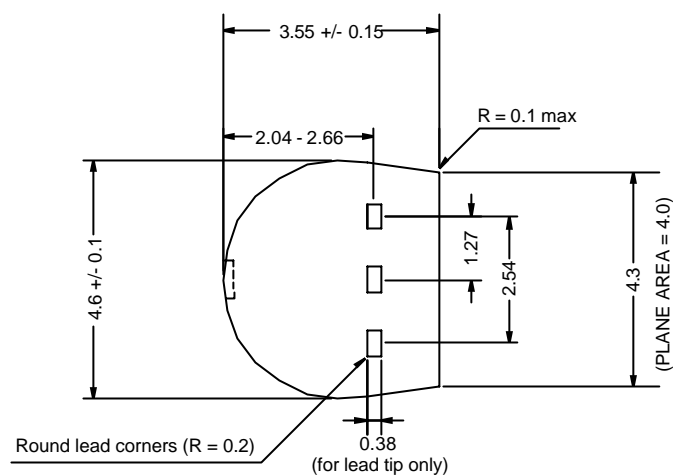


## 5 LEAD SOT-23



## NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. PACKAGE OUTLINE DIMENSIONS INCLUSIVE OF METAL BURR.
3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.076MM.
4. ALL PACKAGE SURFACE TO BE MIRROR FINISH.
5. MOLDING WITH DIE FACING UP, AND FORMING WITH DIE FACING DOWN.
6. FOOT LENGTH TO BE MEASURED AT THE INTERCEPT POINT OF EXTERNAL LEADS AND DATUM "A".
7. LEADFINISH PLATING: 0.00762MM - 0.0254MM. PACKAGE OUTLINE EXCLUSIVE OF LEADFINISH PLATING.



Doc. No. 4006, Rev. J

## REVISION HISTORY

Date	Rev.	Reason
12/15/03	J	Updated typical performance characteristics legend for Delta Reference voltage

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# CATALYST

Catalyst Semiconductor, Inc.  
Corporate Headquarters  
1250 Borregas Avenue  
Sunnyvale, CA 94089  
Phone: 408.542.1000  
Fax: 408.542.1200  
[www.catalyst-semiconductor.com](http://www.catalyst-semiconductor.com)

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