

## PROGRAMMABLE SHUNT VOLTAGE REFERENCE

- ADJUSTABLE OUTPUT VOLTAGE  
2.5 to 24V
- SEVERAL PRECISION @ 25°C  
±2%, ±1% and ±0.5%
- SINK CURRENT CAPABILITY  
1 to 100mA
- INDUSTRIAL TEMPERATURE RANGE:  
-40 to +105°C
- PERFORMANCES COMPATIBLE WITH  
INDUSTRY STANDARD TL431

### DESCRIPTION

The TS2431 is a programmable shunt voltage reference with guaranteed temperature stability over the entire temperature range of operation (-40 to +105°C). The output voltage may be set to any value between 2.5V and 24V with an external resistor bridge.

Available in SOT23-3 surface mount package, it can be designed in applications where space saving is a critical issue.

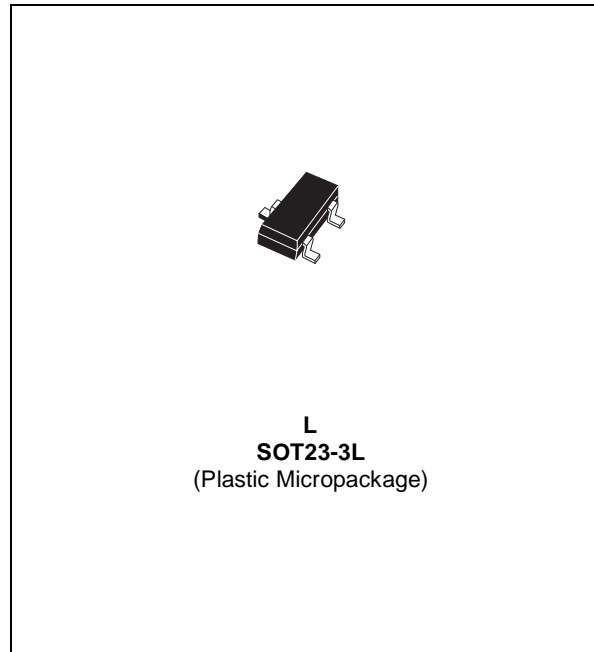
### APPLICATION

- Computers
- Instrumentation
- Battery chargers
- Switch Mode Power Supply
- Battery operated equipments

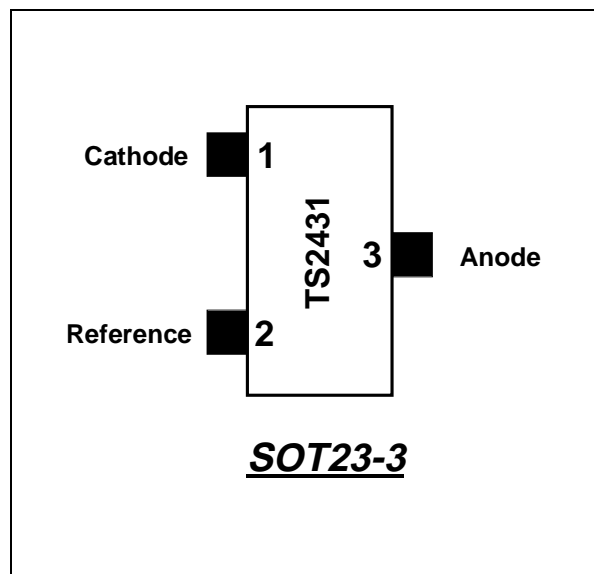
### ORDER CODE

Precision	Part Number in SOT23-3	SOT23 Marking
2%	TS2431ILT	L285
1%	TS2431AILT	L286
0.5%	TS2431BILT	L287
Single temperature range: -40 to +105°C		

LT = Tiny Package (SOT23-3) - only available in Tape & Reel (LT)



### PIN CONNECTIONS (top view)



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
V <sub>ka</sub>	Cathode to Anode voltage	25	V
I <sub>K</sub>	Reverse Breakdown Current	-100 to +150	mA
I <sub>REF</sub>	Reference input current range	-0.05 to +10	mA
P <sub>d</sub>	Power Dissipation <sup>1)</sup> SOT23-3	360	mW
T <sub>std</sub>	Storage Temperature	-65 to +150	°C
ESD	Human Body Model (HBM)	2	kV
	Machine Model (MM)	200	V
T <sub>LEAD</sub>	Lead Temperature (soldering, 10 seconds)	260	°C

1. P<sub>d</sub> has been calculated with T<sub>amb</sub> = 25°C, T<sub>junction</sub> = 150°C and R<sub>thja</sub> = 340°C/W for the SOT23-3 package

**OPERATING CONDITIONS**

Symbol	Parameter	Value	Unit
V <sub>KA</sub>	Cathode to Anode voltage	V <sub>REF</sub> to 24	V
I <sub>K</sub>	Cathode operating current <sup>1)</sup>	1 to 100	mA
T <sub>oper</sub>	Operating Free Air Temperature Range	-40 to +105	°C

1. Maximum power dissipation must be strictly observed to avoid the component destruction.

**ELECTRICAL CHARACTERISTICS**

T<sub>AMBIENT</sub> = 25°C (unless otherwise specified)

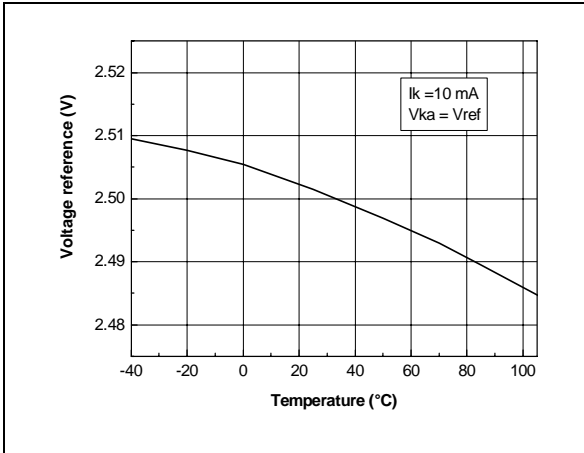
Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V <sub>REF</sub>	Reference input Voltage	V <sub>K</sub> =V <sub>REF</sub> , I <sub>K</sub> =10mA		2.5		V
		TS2431 (2%)	2.45		2.55	
		TS2431A (1%)	2.475		2.525	
		TS2431B (0.5%)	2.488		2.512	
ΔV <sub>REF</sub>	Reference input Voltage deviation over temperature, V <sub>K</sub> =V <sub>REF</sub> , I <sub>K</sub> =10mA (note 1,2)	0°C < T < +70°C		10	20	mV
		-40°C < T < +85°C		17	30	
		-40°C < T < +105°C		20	35	
T <sub>C</sub>	Temperature coefficient (note 2)	-40°C < T < +105°C		50	100	ppm/°C
I <sub>KMIN</sub>	Minimum Operating Current	T = 25°C		0.3	0.8	mA
		-40°C < T < +105°C			1	
$\left  \frac{\Delta V_{ref}}{\Delta V_k} \right $	Ratio of change in reference input voltage to change in cathode to anode voltage	I <sub>K</sub> =10mA V <sub>ka</sub> = 24 to 2.5V		0.3	2	mV/V
I <sub>REF</sub>	Reference input current I <sub>K</sub> =10mA, R1=10KΩ, R2=+∞ (note 3)	T=25°C		0.5	2.5	μA
		-40°C < T < +105°C			3	
ΔI <sub>REF</sub>	Reference input current deviation I <sub>K</sub> =10mA, R1=10KΩ, R2=+∞ (note 3)	-40°C < T < +105°C		0.4	1.2	μA
I <sub>OFF</sub>	Off-state cathode current	V <sub>K</sub> =24V, V <sub>REF</sub> =GND		10	500	nA
Z <sub>KA</sub>	Reverse dynamic impedance	V <sub>K</sub> =V <sub>REF</sub> ΔI <sub>K</sub> =1 to 50mA, f<10kHz		0.5	0.75	Ω
E <sub>N</sub>	Wide Band Noise	I <sub>k</sub> = 10mA 10Hz < f < 10kHz		300		nV/√Hz

**Note 1:** Limits are 100% production tested at 25°C. Limits over temperature are guaranteed through correlation and by design.

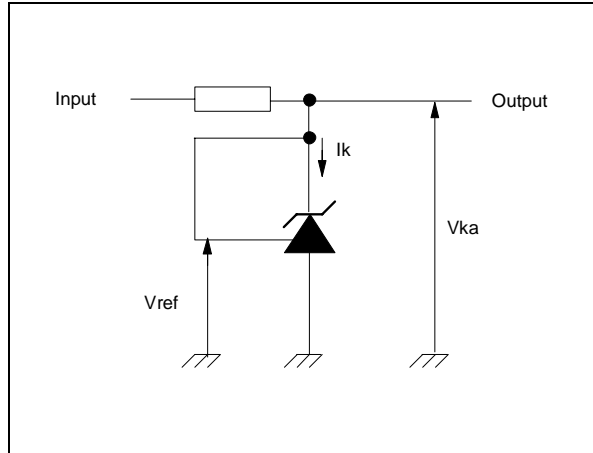
**Note 2:** |ΔV<sub>REF</sub>| is defined as the difference between the maximum and minimum values of V<sub>REF</sub> obtained over the full temperature range

**Note 3:** Refer to figure "Test circuit for V<sub>ka</sub>>V<sub>ref</sub>" page 4

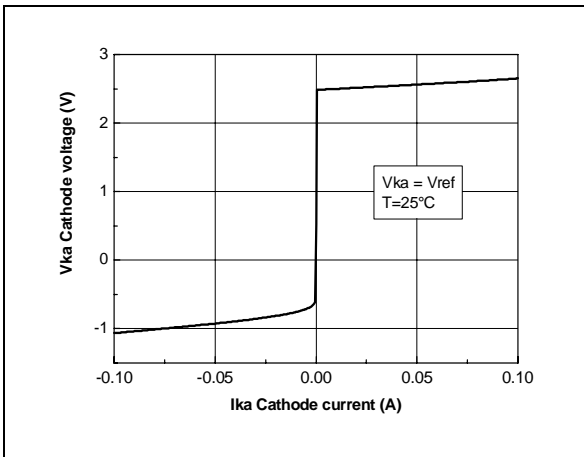
Reference voltage vs temperature



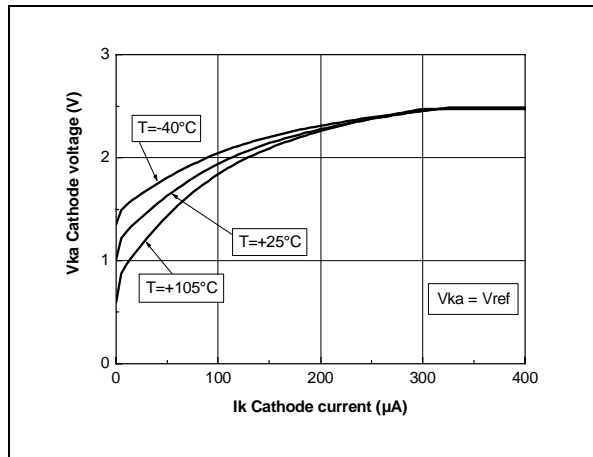
Test circuit for  $V_{ka} = V_{ref}$



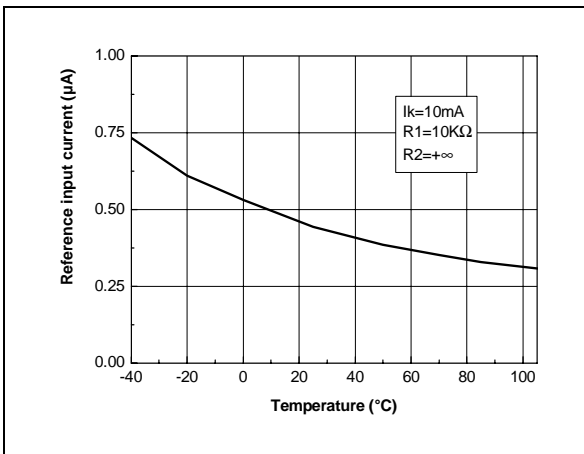
Cathode voltage vs cathode current



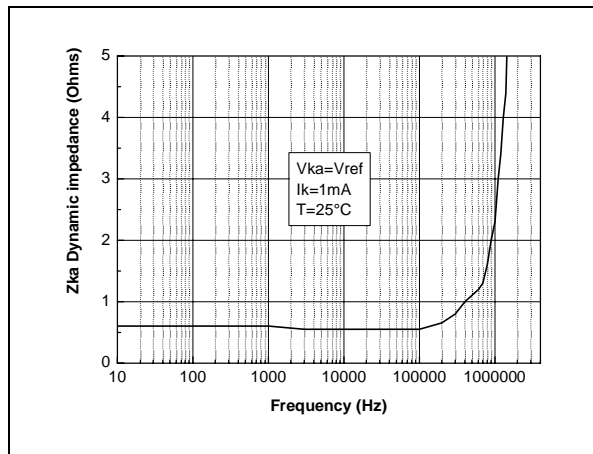
Cathode voltage vs cathode current



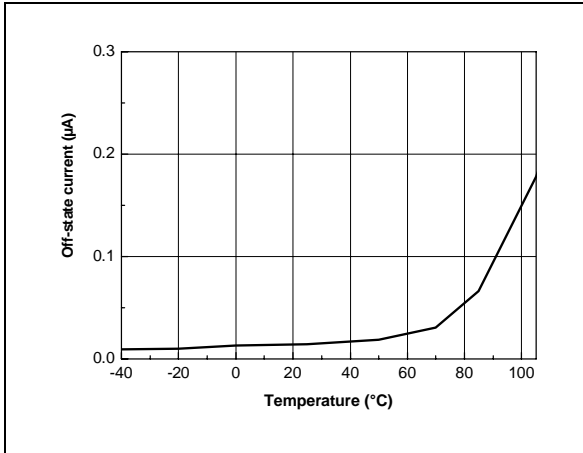
Reference input current vs temperature



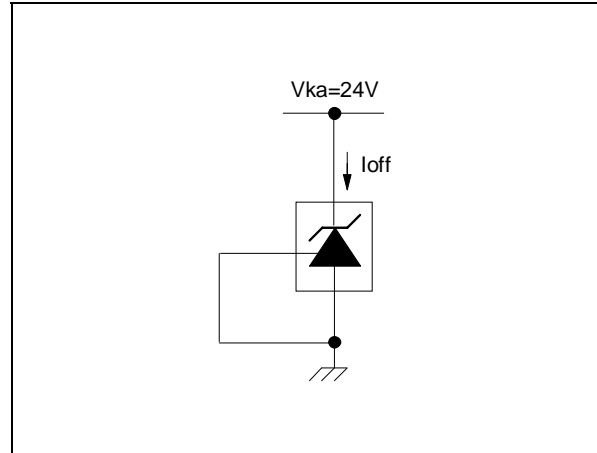
Dynamic impedance vs frequency



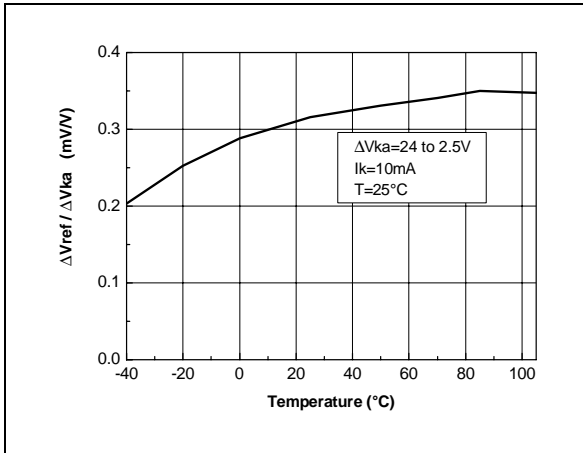
Off-State current vs temperature



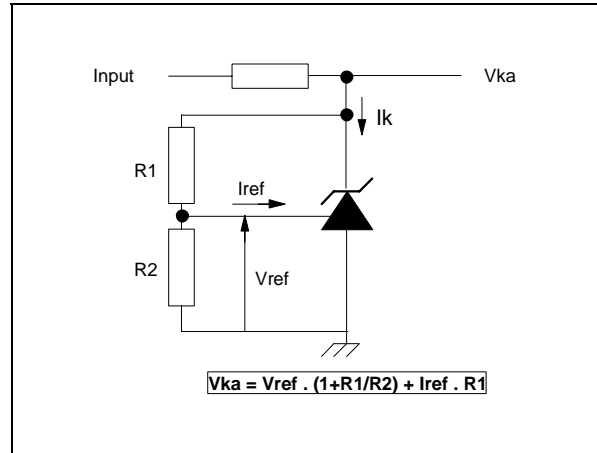
Test circuit for Off-State current measurement



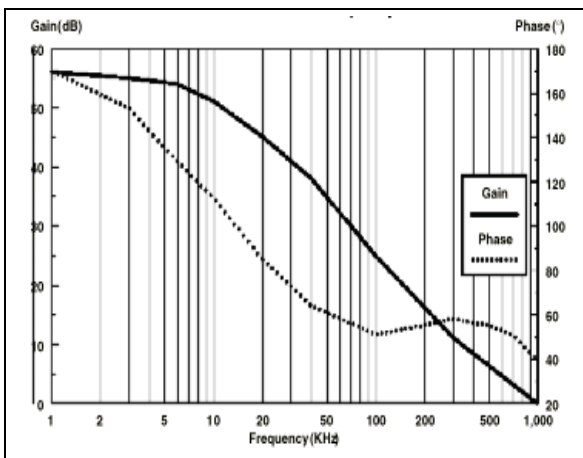
Ratio of change in reference input voltage to change in Vka voltage vs temperature



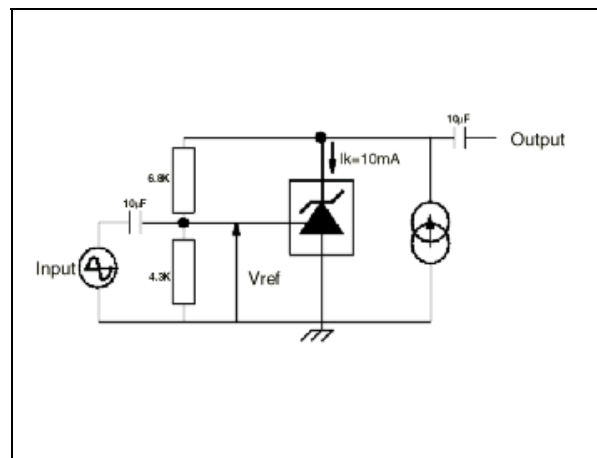
Test circuit for Vka > Vref



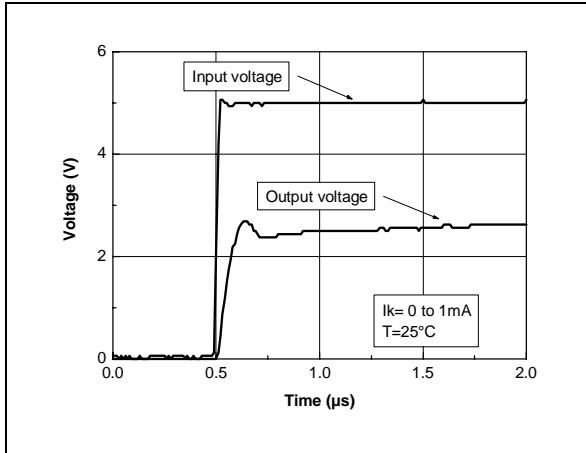
Phase and Gain vs frequency



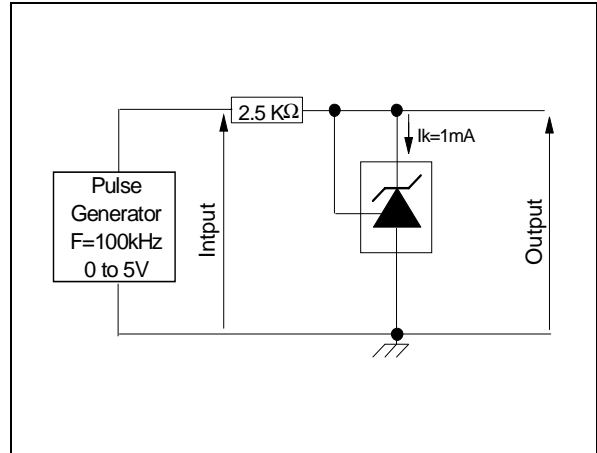
Test circuit for phase and gain measurement



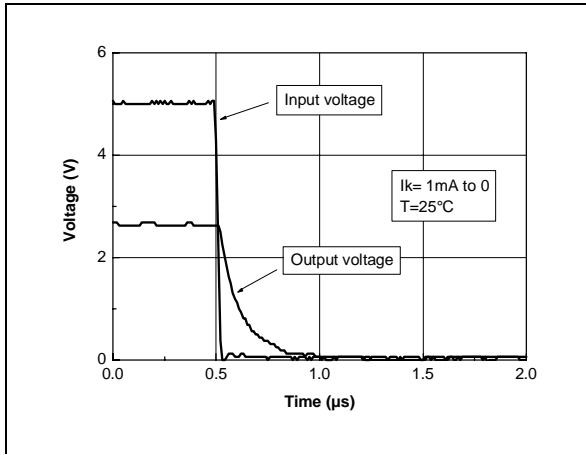
Pulse response at  $I_k=1\text{mA}$



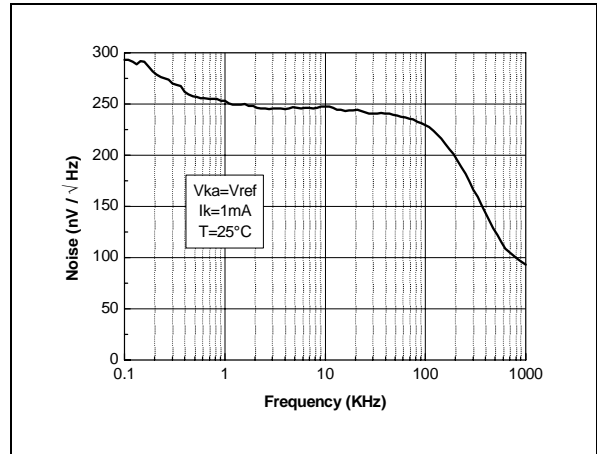
Test circuit for pulse response at  $I_k = 1\text{mA}$



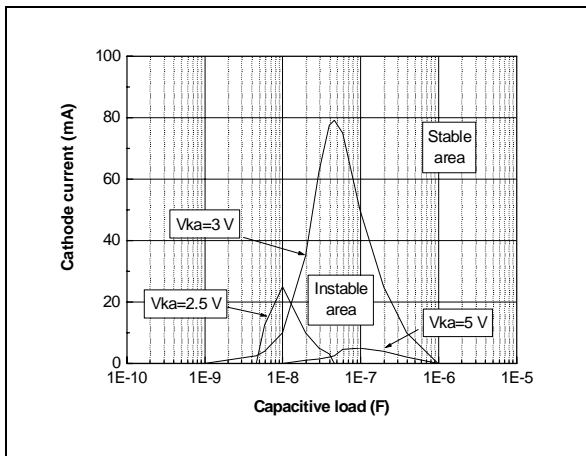
Pulse response at  $I_k = 1\text{mA}$



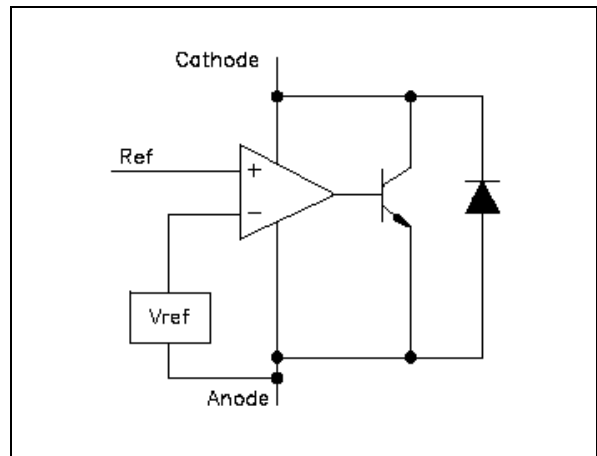
Equivalent input noise vs frequency



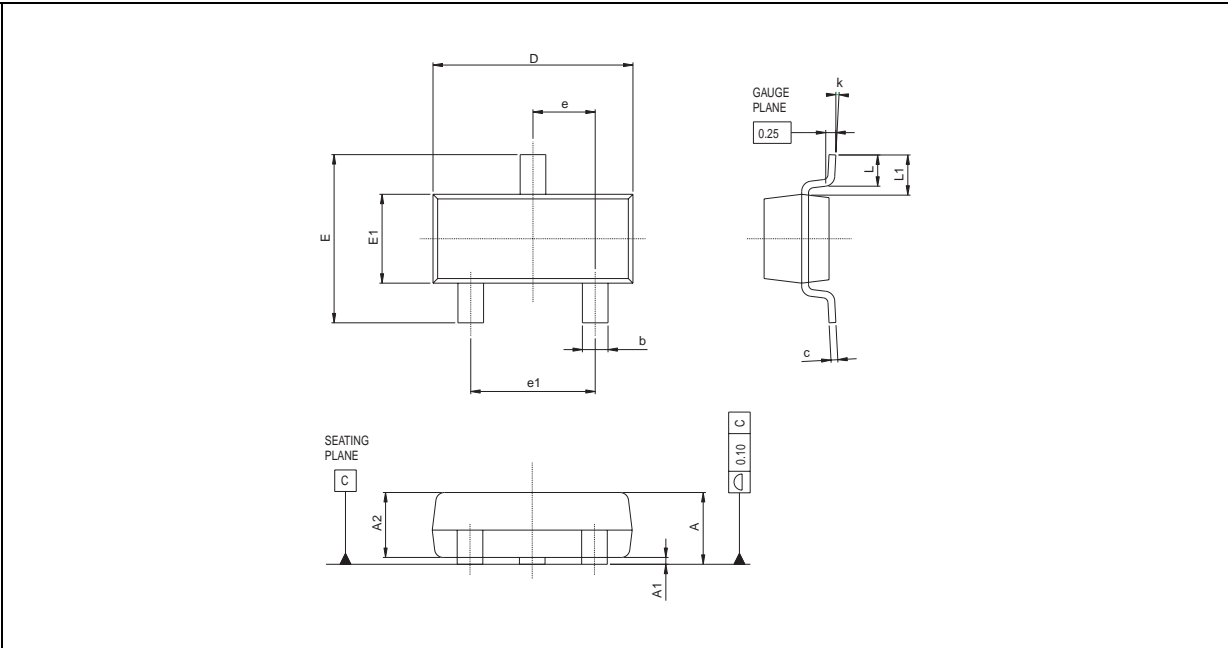
Stability boundary conditions



Block Diagram



**PACKAGE MECHANICAL DATA**  
**3 PINS - TINY PACKAGE (SOT-23)**



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.890		1.120	0.035		0.044
A1	0.010		0.100	0.0004		0.004
A2	0.880	0.950	1.020		0.037	0.040
b	0.300		0.500	0.012		0.020
c	0.080		0.200	0.003		0.008
D	2.800	2.900	3.040	0.110	0.114	0.120
E	2.100		2.640	0.083		0.104
E1	1.200	1.300	1.400	0.047	0.051	0.055
e		0.950			0.037	
e1		1.900			0.075	
L	0.400	0.500	0.600	0.016	0.020	0.024
L1		0.540			0.021	
k	0°		8°			

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