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TS2431

Programmable shunt voltage reference

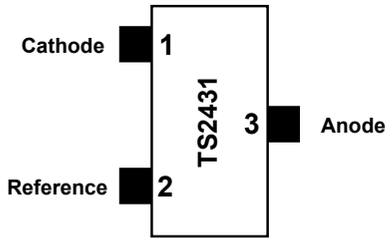
Features

- Adjustable output voltage: 2.5 to 24 V
- Precision selection at 25° C: ±2%, ±1% and ±0.5%
- Sink current capability: 1 to 100 mA
- Industrial temperature range: -40 to +105° C
- Performances compatible with industry-standard TL431



L
SOT23-3L
(plastic micropackage)

Pin connections (top view)



Applications

- Computers
- Instrumentation
- Battery chargers
- Switch mode power supplies
- Battery-operated equipment

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 2.5 and 24 V with an external resistor bridge.

Available in a SOT23-3 surface mount package, the device can be implemented in applications where space-saving is of utmost importance.

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1 Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
Vka	Cathode to anode voltage	25	V
I_K	Reverse breakdown current	-100 to +150	mA
I_{REF}	Reference input current range	-0.05 to +10	mA
P_d	Power dissipation(1) SOT23-3	360	mW
T_{std}	Storage temperature	-65 to +150	°C
ESD	Human body model (HBM)(2)	2	kV
	Machine model (MM)(3)	200	V
T_{LEAD}	Lead temperature (soldering, 10 seconds)	260	°C

1. Pd has been calculated with Tamb = 25°C, Tjunction = 150°C, Rthjc = 110°C/W and Rthja = 340°C/W for the SOT23-3 package.
2. Human body model: a 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5 kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.
3. Machine model: a 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω). This is done for all couples of connected pin combinations while the other pins are floating.

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{KA}	Cathode to anode voltage	V_{REF} to 24	V
I_K	Cathode operating current(1)	1 to 100	mA
T_{oper}	Operating free air temperature range	-40 to +105	°C

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

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2 Electrical characteristics

Table 3. Electrical characteristics (Tamb = 25° C unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{REF}	Reference input voltage	$V_K = V_{REF}$, IK =10 mA		2.5		V
		TS2431 (2%)	2.45		2.55	
		TS2431A (1%)	2.475		2.525	
		TS2431B (0.5%)	2.488		2.512	
$\lvert \Delta V_{REF} \rvert$	Reference input voltage deviation over temperature $V_K = V_{REF}$, I_K = 10 mA(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_C	Temperature coefficient (note 2)	-40° C < T < +105° C		50	100	ppm/°C
I_{KMIN}	Minimum operating current	T = 25° C		0.3	0.8	mA
		-40° C < T < +105° C			1	
$\left\lvert \frac{\Delta Vref}{\Delta Vk} \right\rvert$	Ratio of change in reference input voltage to change in cathode to anode voltage	I_K = 10 mA Vka = 24 to 2.5 V		0.3	2	mV/V
I_{REF}	Reference input current I_K = 10 mA, R1 = 10 KΩ, R2 = + ∞ (3)	T = 25° C		0.5	2.5	µA
		-40° C < T < +105° C			3	
$\lvert \Delta I_{REF} \rvert$	Reference input current deviation I_K = 10 mA, R1 = 10 KΩ, R2 = + ∞ (3)	-40° C < T < +105° C		0.4	1.2	µA
I_{OFF}	Off-state cathode current	V_K = 24 V, V_{REF} = GND		10	500	nA
$\lvert Z_{KA} \rvert$	Reverse dynamic impedance	$V_K = V_{REF}$ ΔI_K = 1 to 50 mA, f < 10 kHz		0.5	0.75	W
E_N	Wide band noise	Ik = 10 mA 10 Hz < f < 10 kHz		300		nV/√Hz

1. Limits are 100% production tested at 25° C. Limits over temperature are guaranteed through correlation and by design.
2. $\lvert \Delta V_{REF} \rvert$ is defined as the difference between the maximum and minimum values of V_{REF} obtained over the full temperature range.
3. Refer to *Figure 4: Test circuit for Vka = Vref on page 4*.

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Figure 1. Reference voltage vs temperature

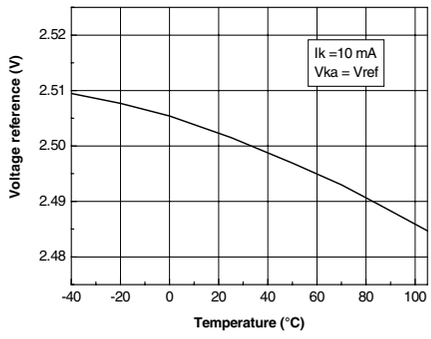


Figure 2. Cathode voltage vs cathode current

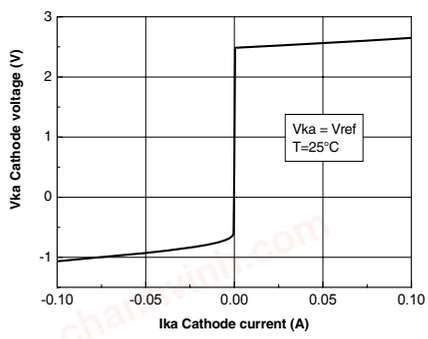


Figure 3. Reference input current vs temperature

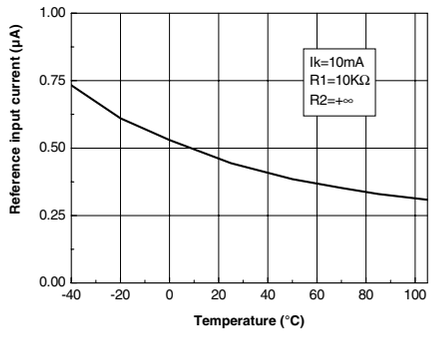


Figure 4. Test circuit for Vka = Vref

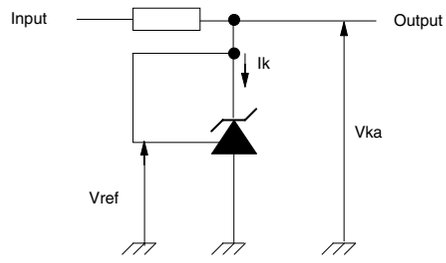


Figure 5. Cathode voltage vs cathode current

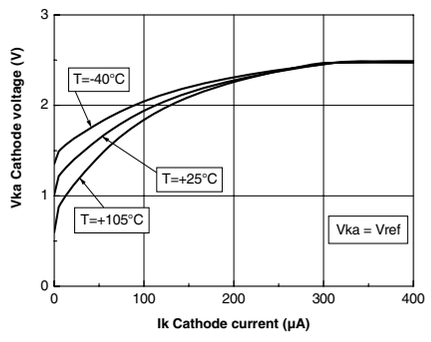
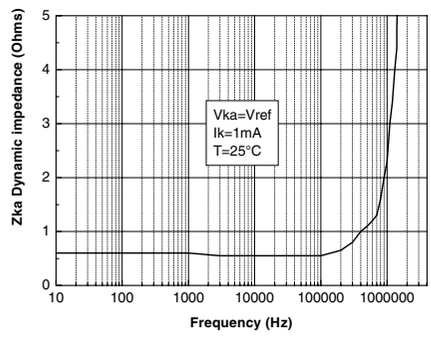


Figure 6. Dynamic impedance vs frequency



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Figure 7. Off-state current vs temperature

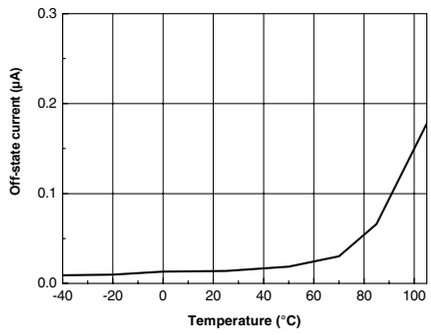


Figure 8. Ratio of change in reference input voltage to change in Vka voltage vs temperature

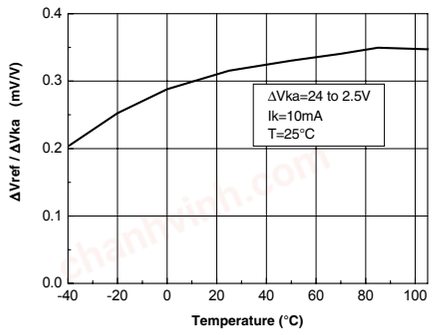


Figure 9. Phase and gain vs frequency

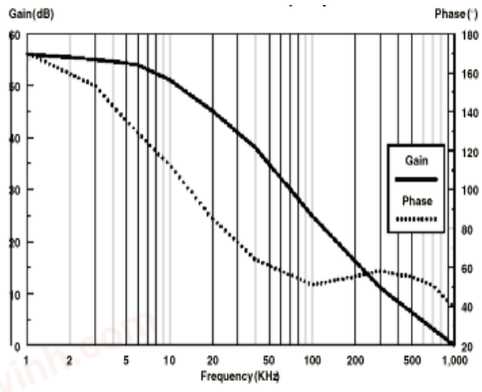


Figure 10. Test circuit for off-state current measurement

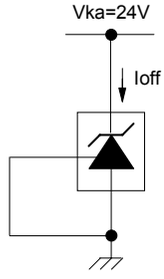
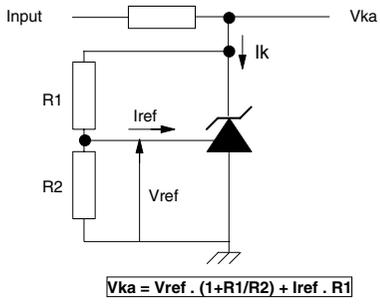
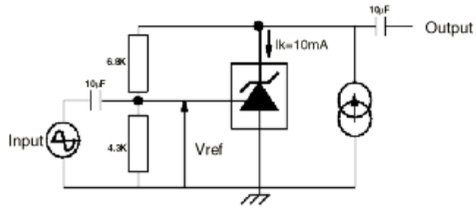


Figure 11. Test circuit for Vka > Vref



$$Vka = Vref . (1+R1/R2) + Iref . R1$$

Figure 12. Test circuit for phase and gain measurement



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Figure 13. Pulse response at I k = 1 mA

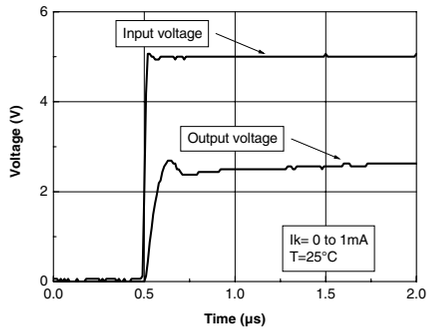


Figure 14. Pulse response at I k = 1 mA

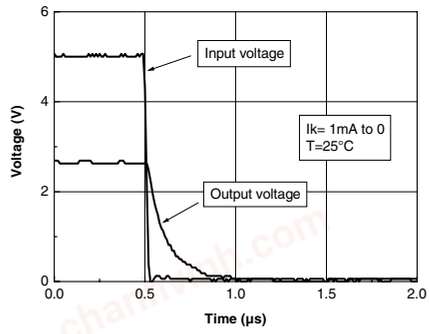


Figure 15. Stability boundary conditions

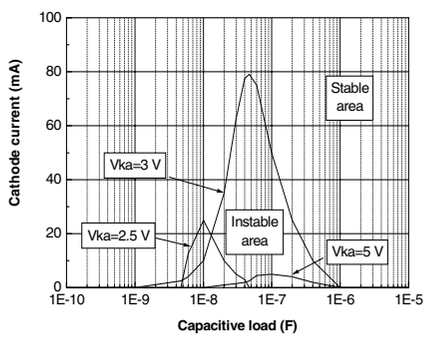


Figure 16. Test circuit for pulse response at I k = 1 mA

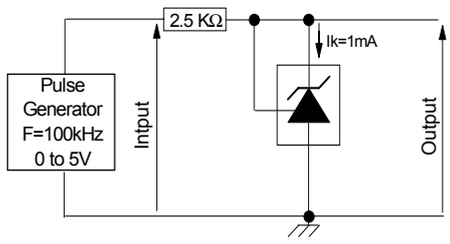


Figure 17. Equivalent input noise vs frequency

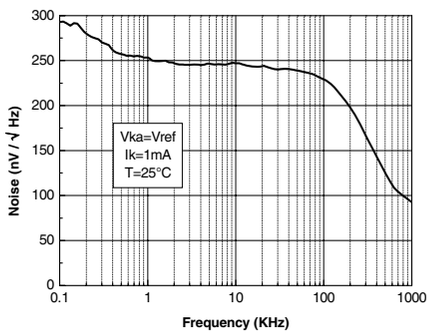
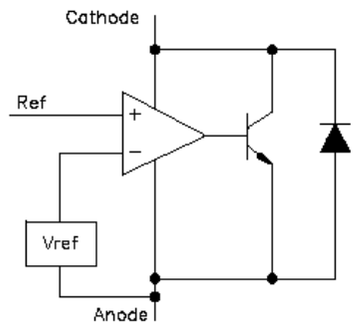


Figure 18. Block Diagram



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3 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*.
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3.1 SOT23-3 package information

Figure 19. SOT23-3 package mechanical drawing

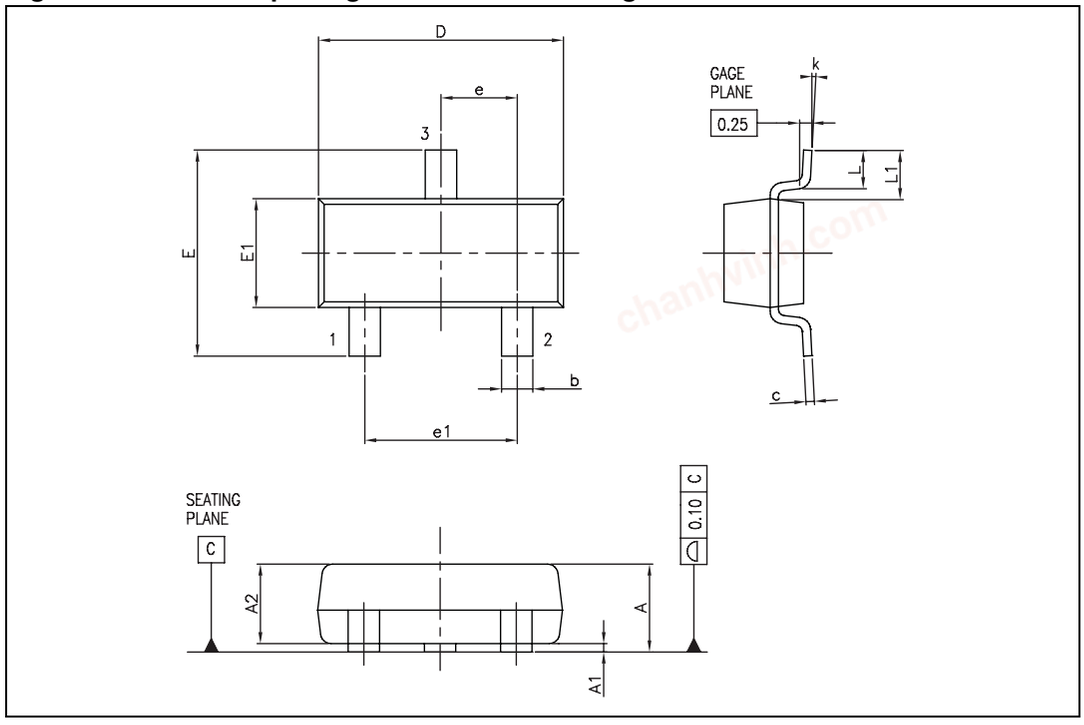


Table 4. SOT23-3 package mechanical data

Dimensions						
Ref.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.89		1.12	0.035		0.044
A1	0.01		0.10	0.0004		0.004
A2	0.88	0.95	1.02	0.035	0.037	0.040
b	0.30		0.50	0.012		0.020
c	0.08		0.20	0.003		0.008
D	2.80	2.90	3.04	0.110	0.114	0.120
E	2.10		2.64	0.083		0.104
E1	1.20	1.30	1.40	0.047	0.051	0.055
e		0.95			0.037	
e1		1.90			0.075	
L	0.40	0.50	0.60	0.016	0.020	0.024
L1		0.54			0.021	
k	0d		8d			

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4 Ordering information

Table 5. Order codes

Order code	Temperature range	Package	Packing	Precision	Marking
TS2431ILT	-40 to +105°C	SOT23-3	Tape & reel	2%	L285
TS2431AILT				1%	L286
TS2431BILT				0.5%	L287
TS2431IYLT(1)		SOT23-3 (automotive grade)		2%	L289
TS2431AIYLT(1)				1%	L290
TS2431BIYLT(1)				0.5%	L291

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q 002 or equivalent are on-going.

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5 Revision history

Table 6. Document revision history

Date	Revision	Changes
01-Feb-2002	1	Initial release.
10-Sep-2009	2	Updated document format. Modified footnote 1 under *Table 1: Absolute maximum ratings on page 2*. Added HBM and MM notes under *Table 1*. Added automotive grade order codes in *Table 5: Order codes*.

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