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

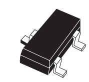
Applications

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

Description

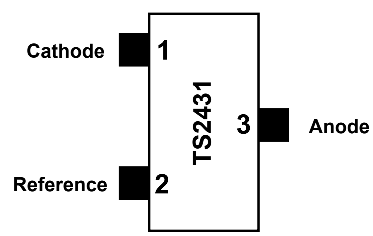
The TS2431 is a programmable shunt voltage reference with guaranteed temperature stability over the entire temperature range of operation -40 to +105° C. The output voltage may be set to any value between 2.5 and 24 V with an external resistor bridge.

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



L
SOT23-3L
(plastic micropackage)

Pin connections (top view)



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.

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	$V_K = V_{REF}$ $\Delta I_K = 1$ 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*.

Figure 1. Reference voltage vs temperature

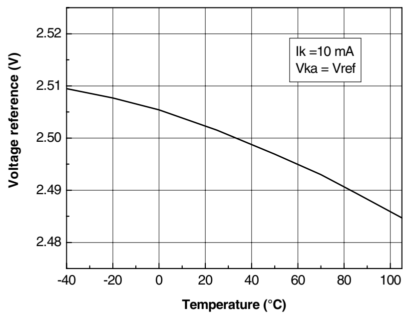


Figure 2. Cathode voltage vs cathode current

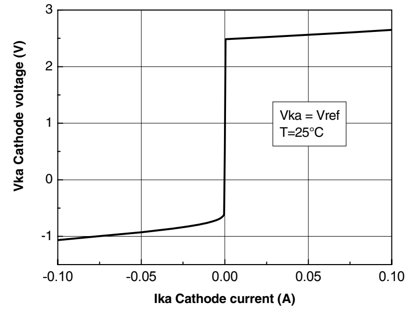


Figure 3. Reference input current vs temperature

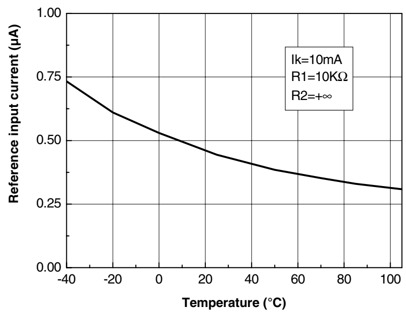


Figure 4. Test circuit for Vka = Vref

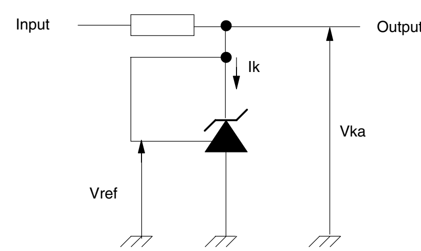


Figure 5. Cathode voltage vs cathode current

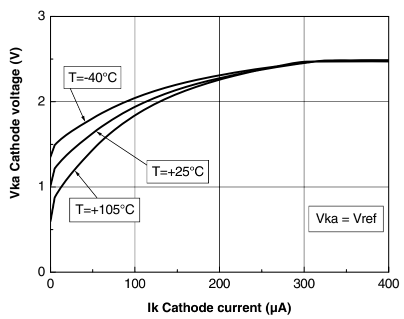
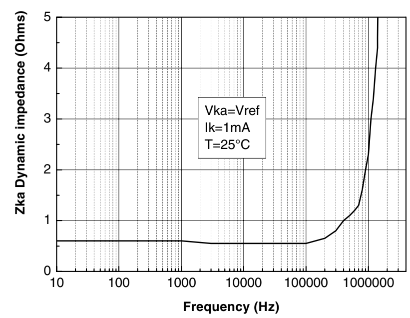


Figure 6. Dynamic impedance vs frequency



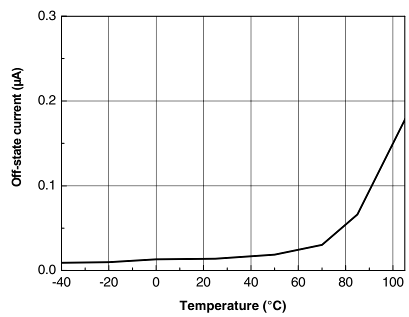


Figure 7. Off-state current vs temperature

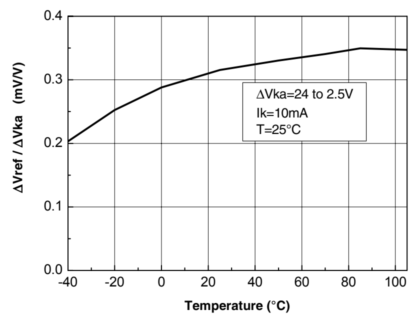


Figure 8. Ratio of change in reference input voltage to change in Vka voltage vs temperature

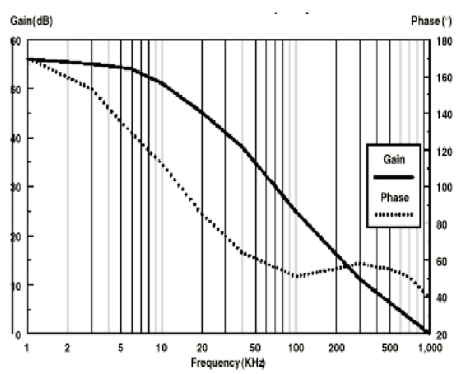


Figure 9. Phase and gain vs frequency

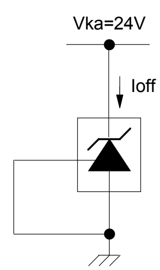


Figure 10. Test circuit for off-state current measurement

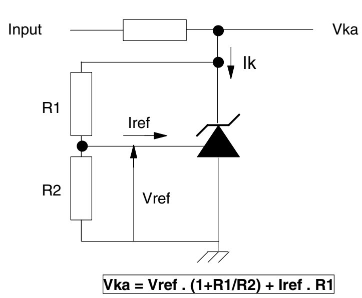


Figure 11. Test circuit for Vka > Vref

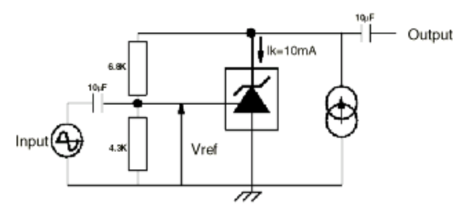


Figure 12. Test circuit for phase and gain measurement

Figure 13. Pulse response at I k = 1 mA

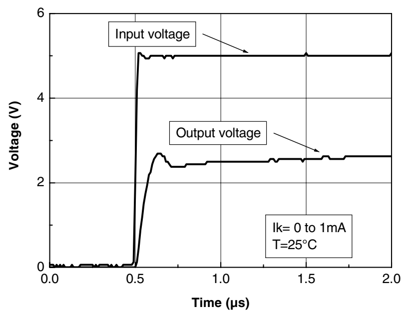


Figure 14. Pulse response at I k = 1 mA

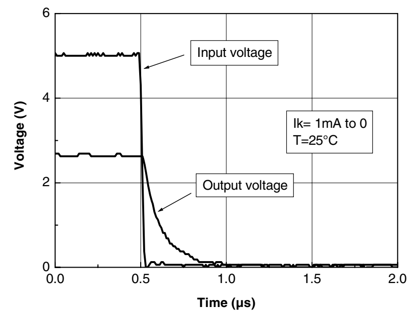


Figure 15. Stability boundary conditions

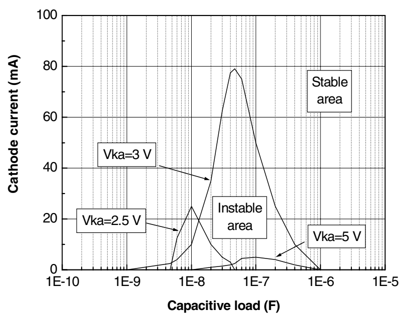


Figure 16. Test circuit for pulse response at I k = 1 mA

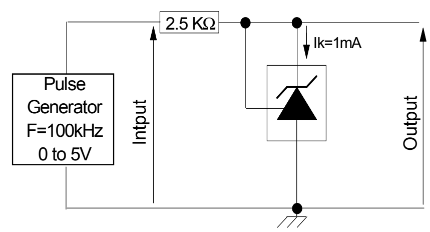


Figure 17. Equivalent input noise vs frequency

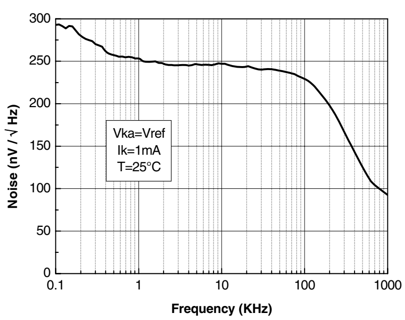
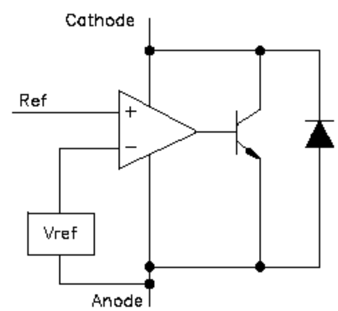


Figure 18. Block Diagram



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*. ECOPACK® is an ST trademark.

3.1 SOT23-3 package information

Figure 19. SOT23-3 package mechanical drawing

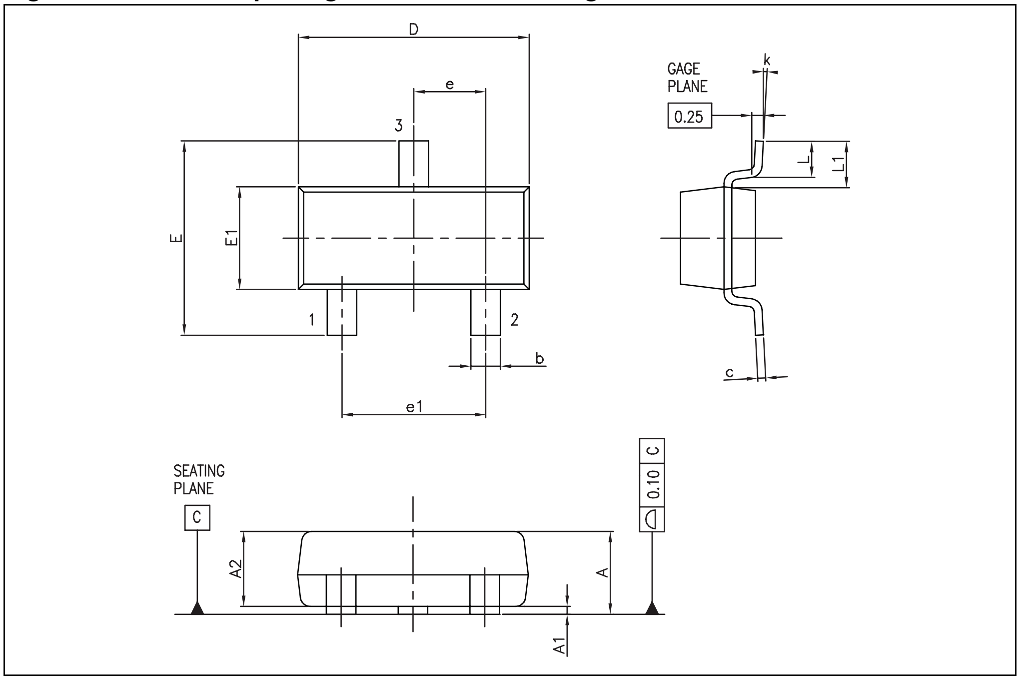


Table 4. SOT23-3 package mechanical data

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			

4 Ordering information

Table 5. Order codes

<table>
<tr><th>Order code</th><th>Temperature range</th><th>Package</th><th>Packing</th><th>Precision</th><th>Marking</th></tr>
<tr><td>TS2431ILT</td><td rowspan="6">-40 to +105°C</td><td rowspan="3">SOT23-3</td><td rowspan="6">Tape & reel</td><td>2%</td><td>L285</td></tr>
<tr><td>TS2431AILT</td><td>1%</td><td>L286</td></tr>
<tr><td>TS2431BILT</td><td>0.5%</td><td>L287</td></tr>
<tr><td>TS2431IYLT(1)</td><td rowspan="3">SOT23-3 (automotive grade)</td><td>2%</td><td>L289</td></tr>
<tr><td>TS2431AIYLT(1)</td><td>1%</td><td>L290</td></tr>
<tr><td>TS2431BIYLT(1)</td><td>0.5%</td><td>L291</td></tr>
</table>

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.

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*.

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com