TS3431

1.24 V programmable shunt voltage reference

Datasheet — production data

Features

- Adjustable output voltage: 1.24 to 24 V
- Several precision levels @ 25°C ± 2%, ± 1%, ± 0.5% and ± 0.25%
- Sink current capability: 0.4 to 100 mA
- Industrial temperature range: - 40°C to +125°C
- Performance compatible with industry standard TL431

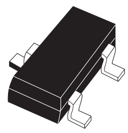
Applications

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

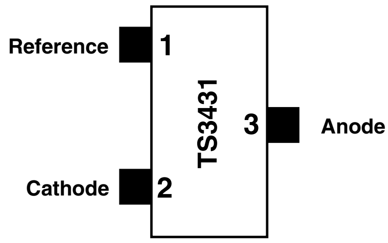
Description

The TS3431 is a programmable shunt voltage reference with guaranteed temperature stability over the entire operating temperature range (- 40 °C to + 125 °C). The output voltage can be set to any value between 1.24 V and 24 V with an external resistor bridge.

Available in SOT23-3 surface mount package, it can be used in application designs where space saving is critical.



L
SOT23-3L
(Plastic micropackage)



SOT23-3
(top view)

This is information on a product in full production. www.st.com

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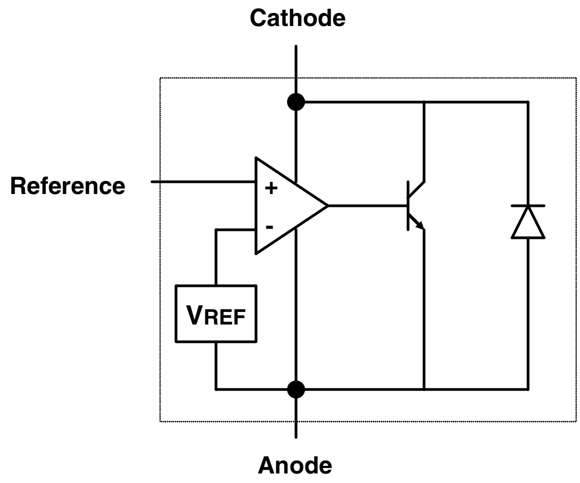
1 Block diagram

Figure 1. Block diagram



2 Absolute maximum ratings

Table 1. Absolute maximum ratings (AMR)

Symbol	Parameter	Value	Unit
V_{KA}	Cathode to anode voltage	25	V
I_K	Reverse breakdown current	-100 to +150	mA
I_{REF}	Reference current	-0.05 to10	mA
P_d	Power dissipation [(1)] SOT23-3L	360	mW
T_{stg}	Storage temperature	-65 to +150	°C
ESD	Human body model (HBM)	2	kV
	Machine model (MM)	200	V
T_{lead}	Lead temperature (soldering, 10 seconds)	250	°C

1. P_d is calculated with T_{amb} = 25°C, T_j = 150°C, R_{thjc} = 110°C/W, R_{thja} = 340°C/W.

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
I_K	Cathode operating current	0.5 to 100	mA
V_K	Cathode operating voltage	1.24 to 24	V
T_{oper}	Operating free air temperature range	-40 to +125	°C

3 Electrical characteristics

Table 3. T_{amb} = 25°C (unless otherwise specified) (1)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_K	Reference input voltage I_K = 10 mA, $V_{ka} = V_{ref}$	TS3431 (2%)	1.215	1.24	1.265	V
		TS3431A (1%)	1.228		1.252	
		TS3431B (0.5%)	1.234		1.246	
		TS3431C (0.25%)	1.237		1.243	
ΔV_K	Variation of reference input voltage over temperature, $V_{ka} = V_{ref}$	0°C < T < +70°C			10	mV
		-40°C < T < +105°C			18	
		-40°C < T < +125°C			21	
T_C	Temperature coefficient	-40°C < T < +125°C			100	ppm/°C
I_{Kmin}	Minimum operating current	T = 25°C		0.35	0.4	mA
		-40°C < T < +125°C			0.5	
$\left\|\frac{\Delta Vref}{\Delta Vka}\right\|$	Ratio of change in reference input voltage to change in cathode to anode voltage	I_K=10mA V_K= 24 to 1.24V		1.2	1.5	mV/V
		-40°C < T < +125°C			2	
I_{REF}	Reference input current I_K=10mA, R1=10KΩ, R2=+∞	T= 25°C		0.9	1.5	µA
		-40°C < T < +125°C			2	
ΔI_{REF}	Reference input current deviation I_K=10mA, R1=10KΩ, R2=+	0°C < T < +70°C		0.5	1	µA
		-40°C < T < +125°C		0.9	1.5	
I_{OFF}	Off-state cathode current V_K=24V	T= 25°C		35	500	nA
		-40°C < T < +105°C			1000	
		-40°C < T < +125°C			2000	
R_{KA}	Reverse static impedance	I_K = 1 to 100mA		0.2	0.4	W
E_N	Wideband noise	I_K = 10mA 1kHz < f < 100kHz		100		nV/√ Hz

1. Limits are 100% production tested at 25°C. Behavior at the temperature range limits is guaranteed through correlation and by design.

Figure 2. Reference voltage vs. temperature

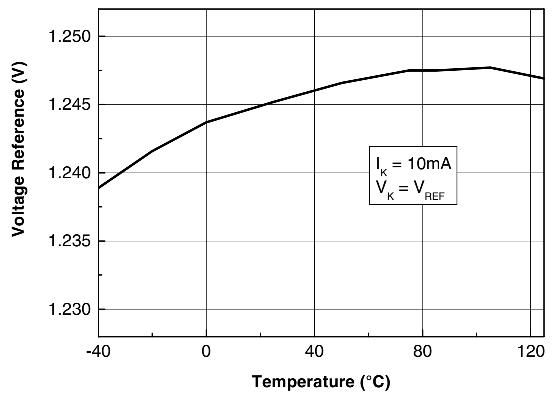


Figure 3. Test circuit for V_K = Vref

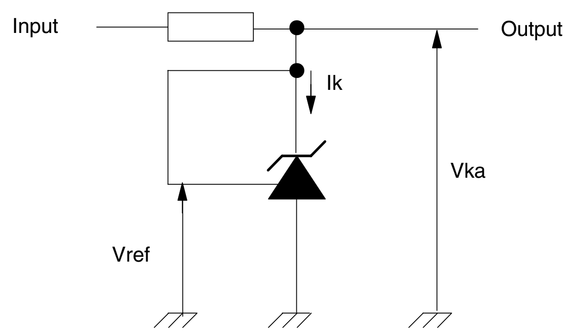


Figure 4. Cathode voltage vs. cathode current

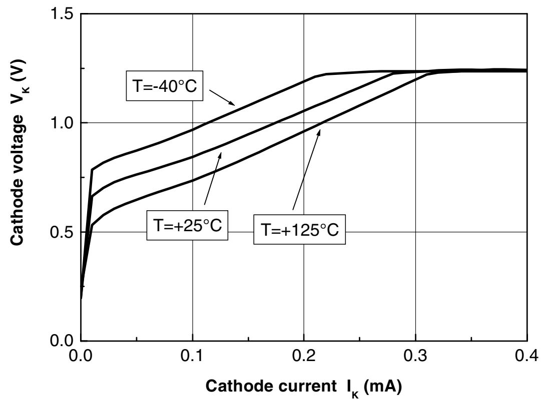


Figure 5. Minimum operating current vs. temperature

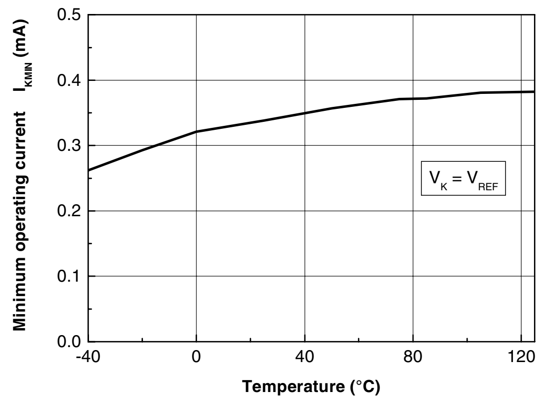


Figure 6. Reference input current vs. temperature

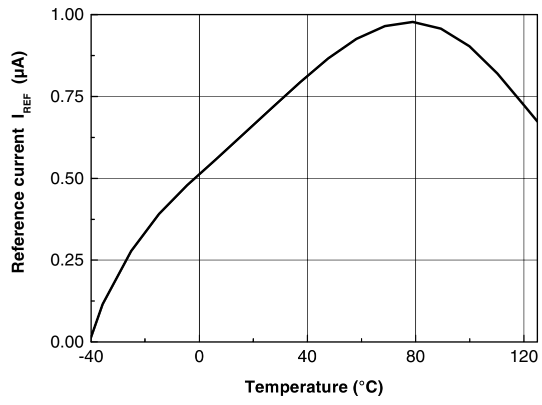


Figure 7. Dynamic impedance vs frequency

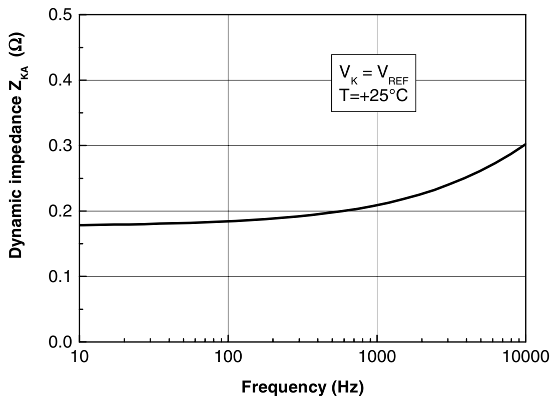


Figure 8. Off-state current vs temperature

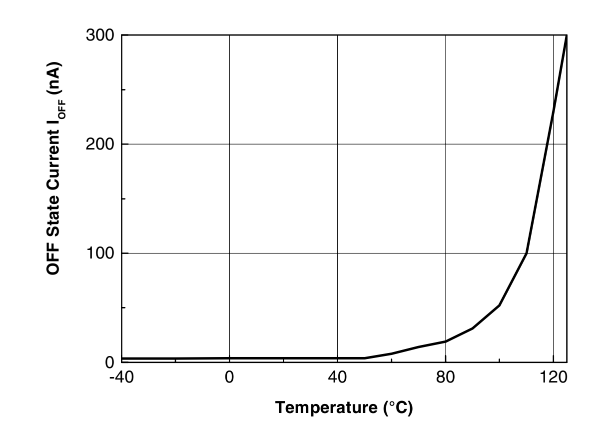


Figure 9. Test circuit for off-state current measurement

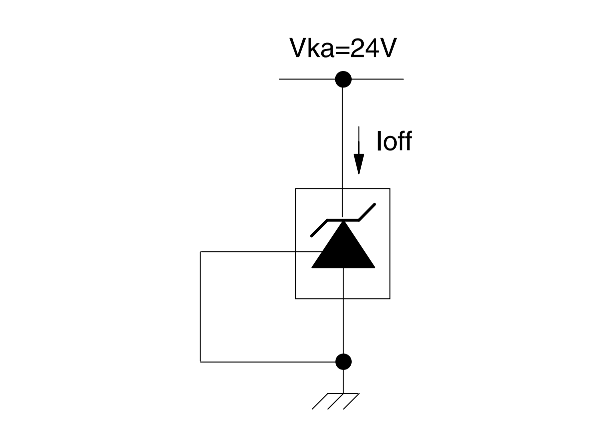


Figure 10. Ratio of change in reference input voltage to change in V_{KA} voltage vs. temperature

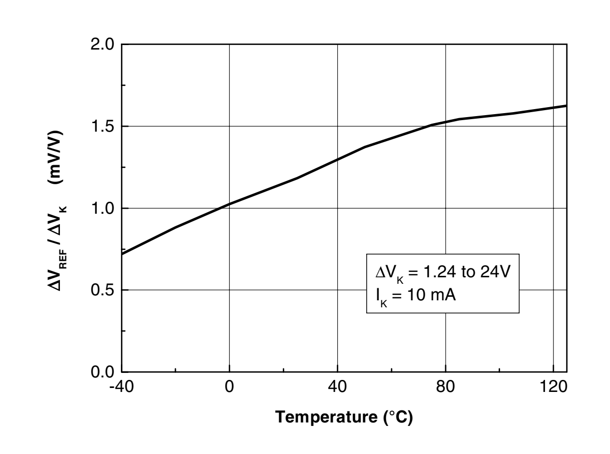


Figure 11. Test circuit for $V_K > V_{REF}$

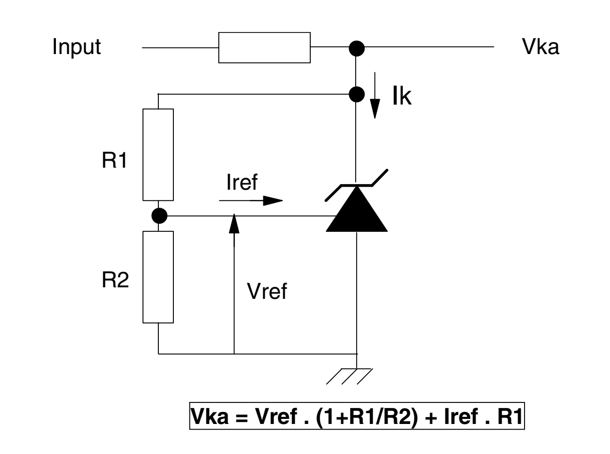


Figure 12. Pulse response at I_K=1mA

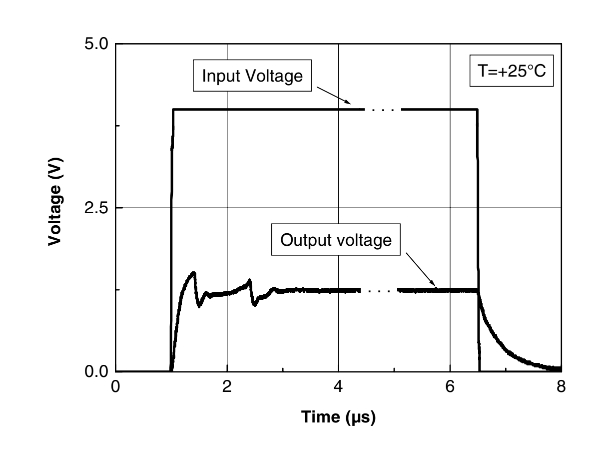


Figure 13. Test circuit for pulse response at I_K = 1mA

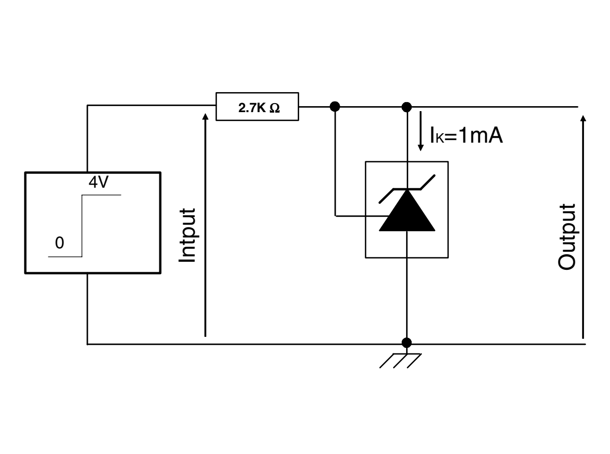


Figure 14. Pulse response at I_K = 10mA

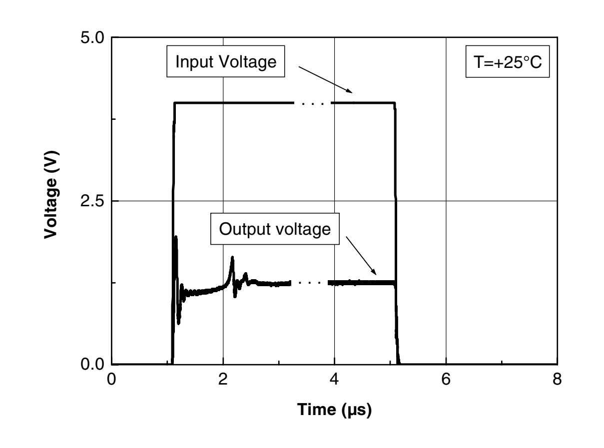


Figure 15. Test circuit for pulse response at I_K = 10mA

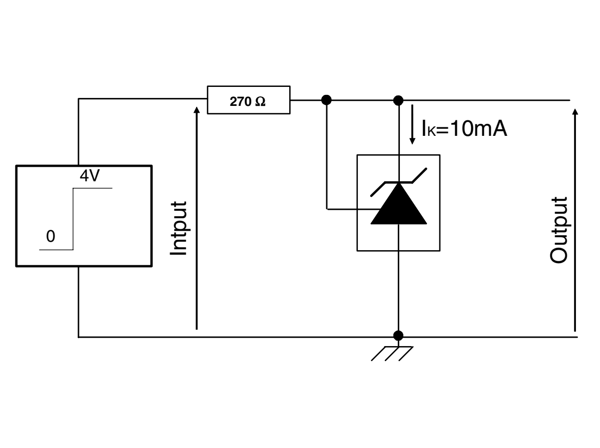


Figure 16. Phase and gain vs frequency

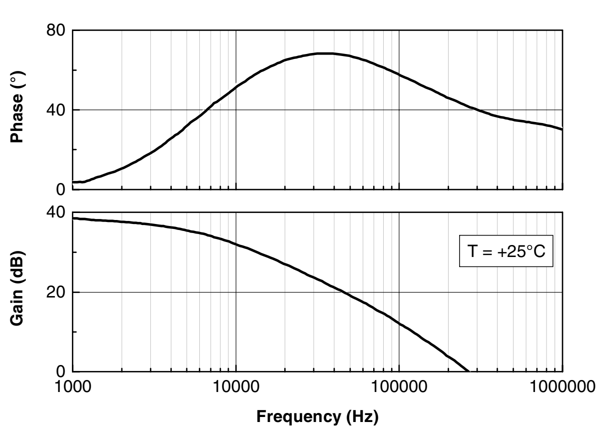


Figure 17. Equivalent input noise vs. frequency

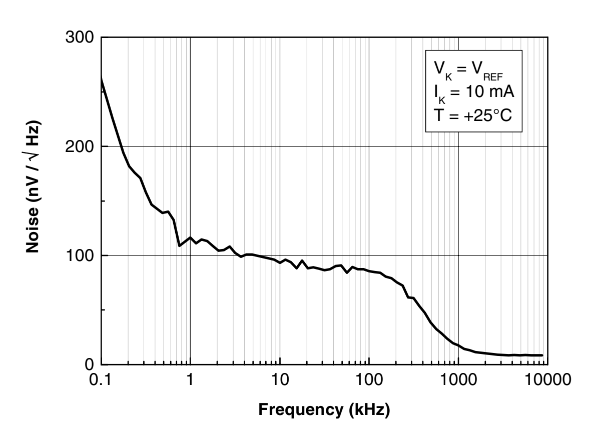
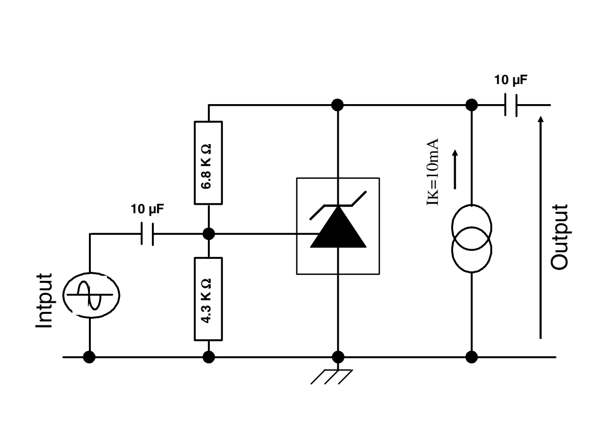


Figure 18. Test circuit for phase and gain measurement

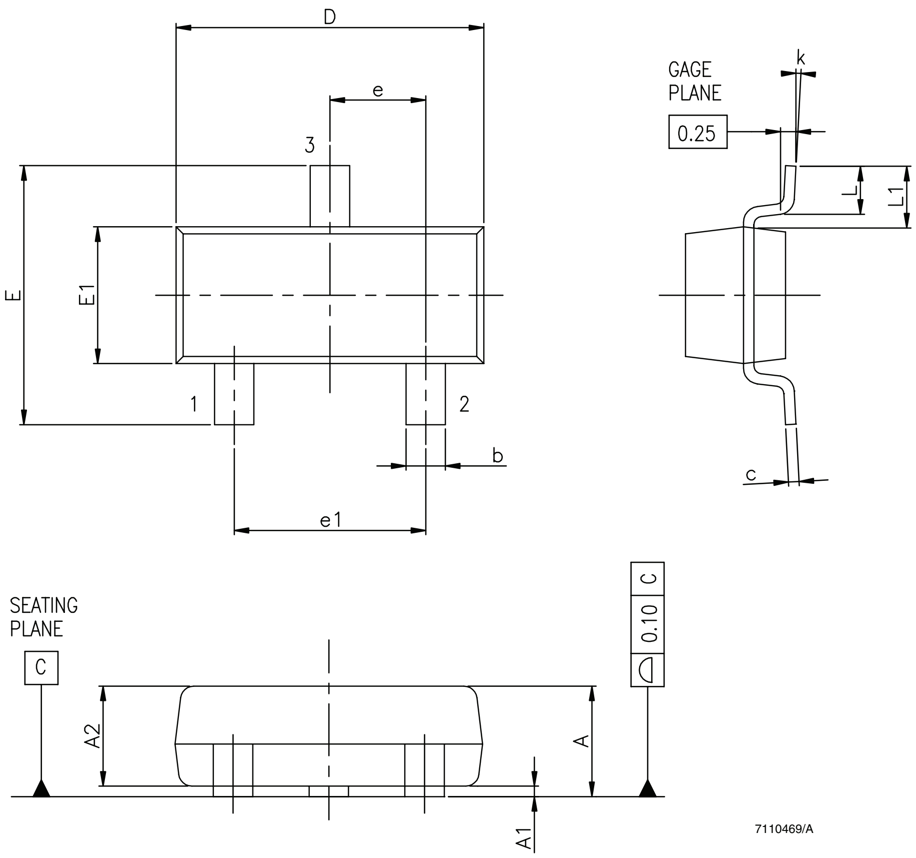


4 Package mechanical data

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.

Table 4. SOT23-3L package mechanical data

Ref.	Dimensions					
	Millimeters			Mils		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.890		1.120	35.05		44.12
A1	0.010		0.100	0.39		3.94
A2	0.880	0.950	1.020	34.65	37.41	40.17
b	0.300		0.500	11.81		19.69
C	0.080		0.200	3.15		7.88
D	2.800	2.900	3.040	110.26	114.17	119.72
E	2.100		2.64	82.70		103.96
E1	1.200	1.300	1.400	47.26	51.19	55.13
e		0.950			37.41	
e1		1.900			74.82	
L	0.400		0.600	15.75		23.63
L1		0.540			21.27	
k	0°		8°	0°		8°



5 Ordering information

Table 5. Order codes

Part numbers	Temperature range	Package	Packaging	Marking
TS3431ILT TS3431AILT TS3431BILT TS3431CILT	-40°C, +125°C	SOT23-3L	Tape & reel	L280 L281 L282 L283

6 Revision history

Table 6. Document revision history

Date	Revision	Changes
1-Jan-2004	1	Initial release.
1-Dec-2004	2	Specific content changes as follows: – CI version added in *Table 5: Order codes*. – R_{thjc} information added in *Table 1: Absolute maximum ratings (AMR)*. – Test condition added in electrical characteristics *Table 3*.
26-Jun-2007	3	Removed TO-92 package information and associated order codes. Re-ordered electrical characteristics figures.
30-Aug-2012	4	Added: $V_{ka} = V_{ref}$ parameter in *Table 3 on page 5*.