

## 2.495V Programmable Shunt Voltage Reference

### DESCRIPTION

TS431 integrated circuits are three-terminal programmable shunt regulator diodes. These monolithic IC voltage references operate as a low temperature coefficient zener which is programmable from  $V_{REF}$  to 36V with two external resistors. These devices exhibit a wide operating current range to 250mA with a typical dynamic impedance of  $0.2\Omega$ . The characteristics of these references make them excellent replacements for zener diodes in many applications such as digital voltmeters, power supplies, and op amp circuitry. The 2.495V reference makes it convenient to obtain a stable reference from 5.0V logic supplies, and since The TS431 operates as a shunt regulator, it can be used as either a positive or negative stage reference.

### FEATURES

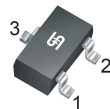
- Programmable Output Voltage up to 36V
  - TS431A –  $V_{REF}$  2.495V  $\pm 1\%$  tolerance
  - TS431B –  $V_{REF}$  2.495V  $\pm 0.5\%$  tolerance
- Fast Turn-On Response
- Sink Current Capability: 120mA
- Low Dynamic Output Impedance:  $0.2\Omega$  (Typ.)
- Min. Operating Cathode Current: 0.2mA (Typ.)
- Compliant to RoHS Directive 2011/65/EU and in accordance to WEEE 2002/96/EC
- Halogen-free according to IEC 61249-2-21

### APPLICATION

- SMPS
- Lighting
- Telecommunication
- Home appliance



**SOT-23**

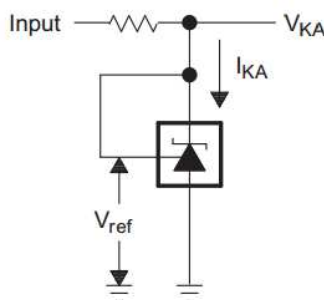


**Pin Definition:**

1. Cathode
2. Reference
3. Anode

**Notes:** MSL 3 (Moisture Sensitivity Level) per J-STD-020

### SIMPLIFIED SCHEMATIC



<b>ABSOLUTE MAXIMUM RATINGS</b> ( $T_A = 25^\circ\text{C}$ unless otherwise noted)			
PARAMETER	SYMBOL	LIMIT	UNIT
Cathode Voltage	$V_{KA}$	36	V
Continuous Cathode Current	$I_K$	120	mA
Reference Input Current	$I_{REF}$	10	mA
Power Dissipation	$P_D$	0.25	W
Operating Temperature Range	$T_{OPER}$	-40 ~ +125	$^\circ\text{C}$
Junction Temperature	$T_J$	+150	$^\circ\text{C}$
Storage Temperature Range	$T_{STG}$	-40 ~ +150	$^\circ\text{C}$

<b>THERMAL PERFORMANCE</b>			
PARAMETER	SYMBOL	LIMIT	UNIT
Thermal Resistance - Junction to Case	$R_{\theta JC}$	110	$^\circ\text{C/W}$
Thermal Resistance - Junction to Ambient	$R_{\theta JA}$	350	$^\circ\text{C/W}$

**Note:** Consider measured with the PCB copper area of approximately 1 in<sup>2</sup> (Multi-Layer)

<b>ELECTRICAL SPECIFICATIONS</b> ( $T_A = +25^\circ\text{C}$ , unless otherwise specified)							
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	
Reference voltage	$V_{REF}$	$V_{KA} = V_{REF}, I_K = 10\text{mA}$ (Figure 1)	TS431A	2.470	2.495	2.520	V
			TS431B	2.483		2.507	
Deviation of reference input voltage	$\Delta V_{REF}$	$V_{KA} = V_{REF}, I_K = 10\text{mA}$ (Figure 1) $T_A = -20 \sim 85^\circ\text{C}$	--	25	35	mV	
Radio of change in Vref to change in cathode Voltage	$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	$I_{KA} = 10\text{mA}$ , (Figure 2)	$V_{KA} = 10\text{V to } V_{REF}$	--	-1.2	-2.0	mV/V
			$V_{KA} = 36\text{V to } 10\text{V}$	--	-1.0	-2.0	
Reference Input current	$I_{REF}$	$R1 = 10\text{k}\Omega, R2 = \infty$ $I_{KA} = 10\text{mA}$ (Figure 2)	--	1.5	3.5	$\mu\text{A}$	
Deviation of reference input current, over temp.	$\Delta I_{REF}$	$R1 = 10\text{k}\Omega, R2 = \infty, I_{KA} = 10\text{mA}$ $T_A = -20 \sim 85^\circ\text{C}$ (Figure 2)	--	0.4	1.2	$\mu\text{A}$	
Off-state Cathode Current	$I_{KA}(\text{off})$	$V_{REF} = 0\text{V}$ (Figure 3), $V_{KA} = 36\text{V}$	--	0.1	1.0	$\mu\text{A}$	
Dynamic Output Impedance	$ Z_{KA} $	$f < 1\text{kHz}, V_{KA} = V_{REF}$ (Figure 1)	--	0.2	0.5	$\Omega$	
Minimum operating cathode current	$I_{KA}(\text{min})$	$V_{KA} = V_{REF}$ (Figure 1)	--	0.2	0.5	mA	

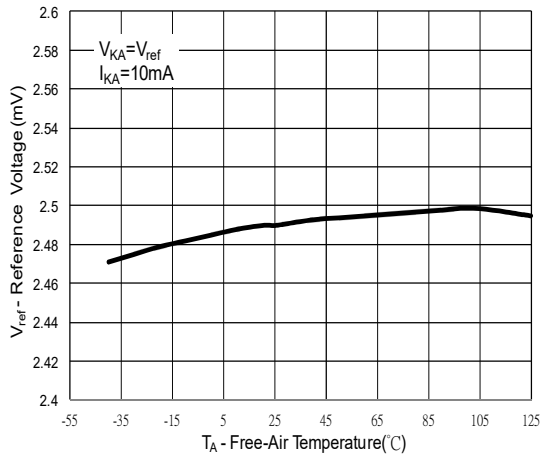
**Note:** The deviation parameters  $\Delta V_{REF}$  and  $\Delta I_{REF}$  are defined as difference between the maximum value and minimum value obtained over the full operating ambient temperature range that applied.

## ORDERING INFORMATION

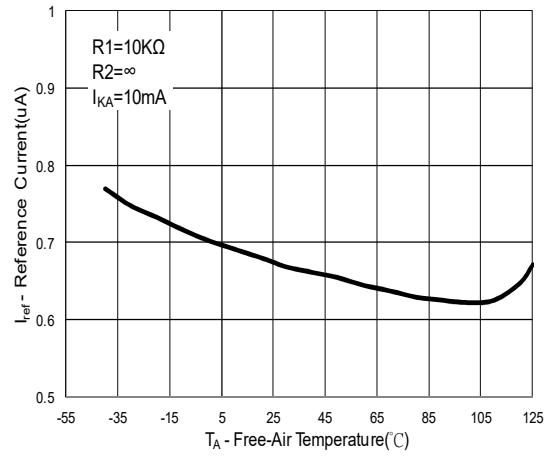
PART NO.	PACKAGE	PACKING
TS431ARIX-Z RFG	SOT-23	3,000pcs / 7" Reel
TS431BRIX-Z RFG	SOT-23	3,000pcs / 7" Reel

**CHARACTERISTICS CURVES**

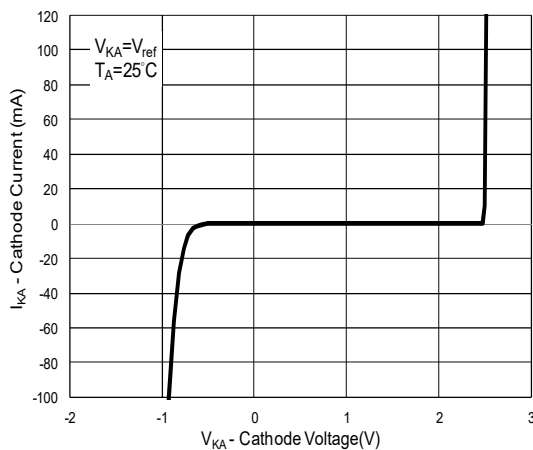
( $T_C = 25^\circ\text{C}$  unless otherwise noted)



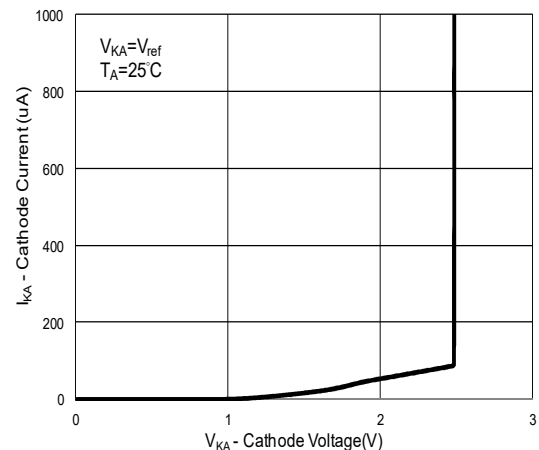
**Figure 1.  $V_{REF}$  vs. Ambient Temperature**



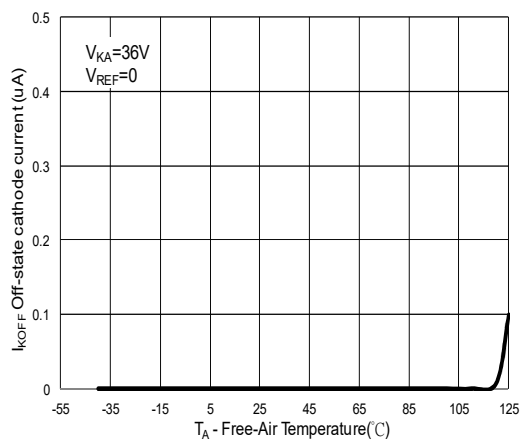
**Figure 2.  $I_{REF}$  vs. Ambient Temperature**



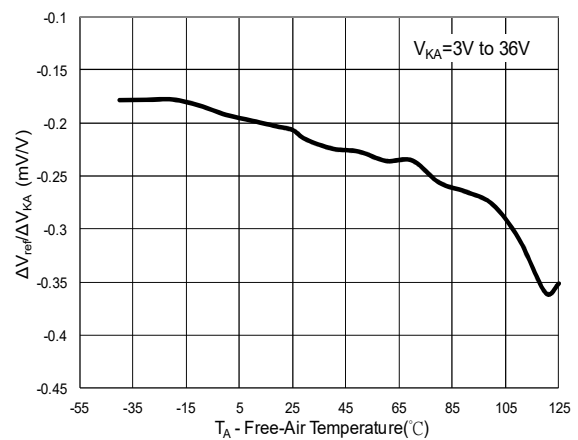
**Figure 3. Cathode Current vs. Cathode Voltage**



**Figure 4. Cathode Current vs. Cathode Voltage**



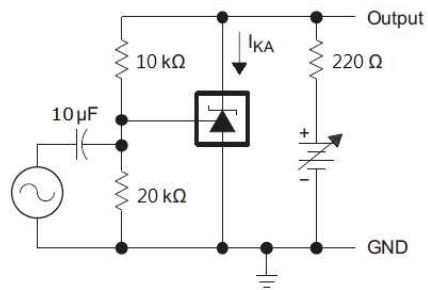
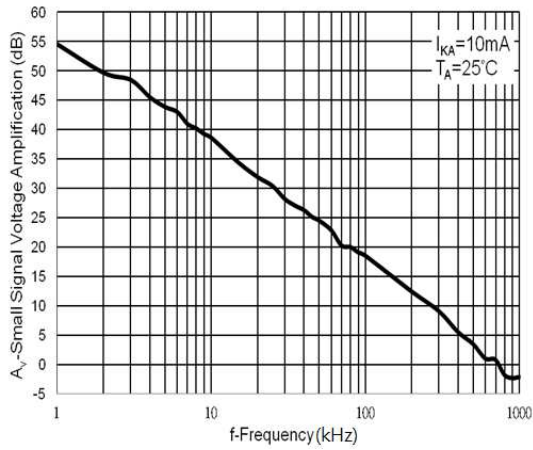
**Figure 5. Off-State Cathode current vs. Ambient Temperature**



**Figure 6. Ratio of delta reference voltage to delta cathode voltage vs. Ambient Temperature**

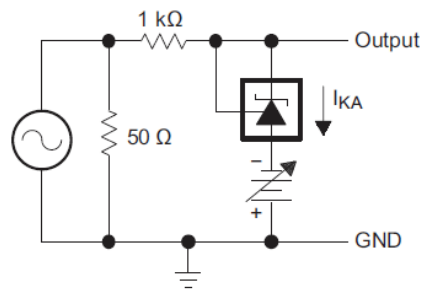
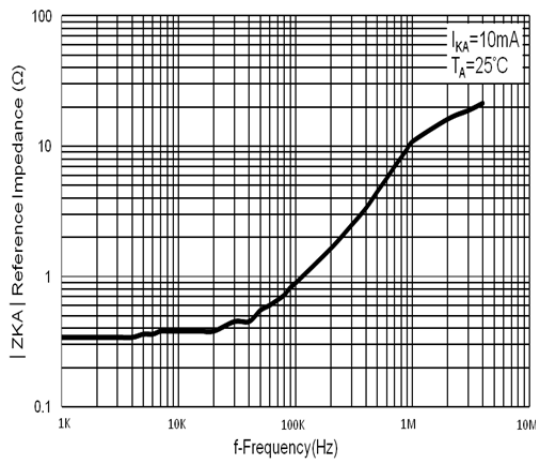
**TYPICAL PERFORMANCE CHARACTERISTICS**

**Small-Signal Voltage Gain and Phase Shift vs. Frequency**



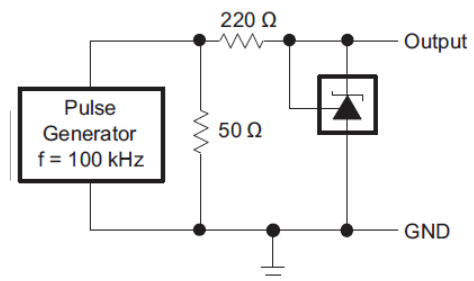
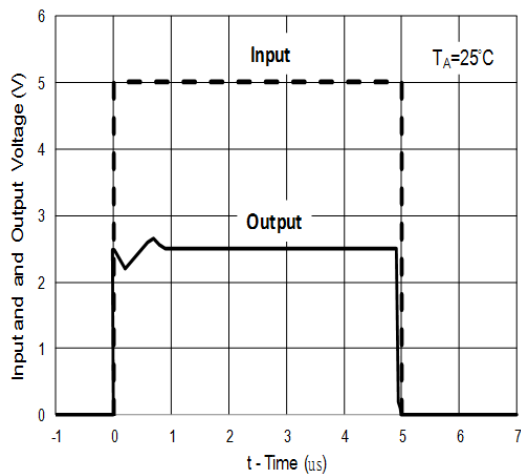
Test Circuit For Voltage Amplification

**Reference Impedance vs. Frequency**



Test Circuit For Reference Impedance

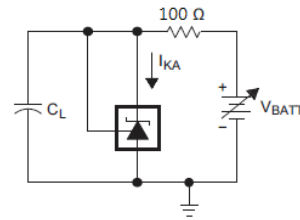
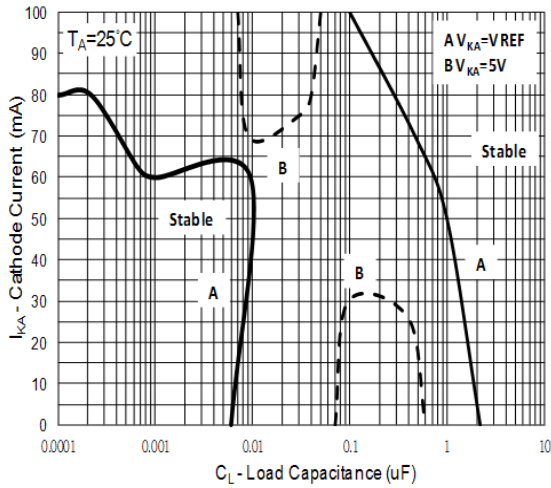
**Pulse Response**



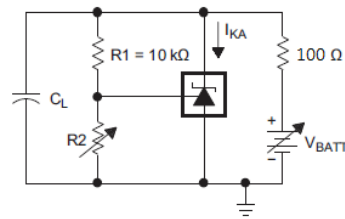
Test Circuit For Pulse Response

**TYPICAL PERFORMANCE CHARACTERISTICS**

**Stability Boundary Condition**



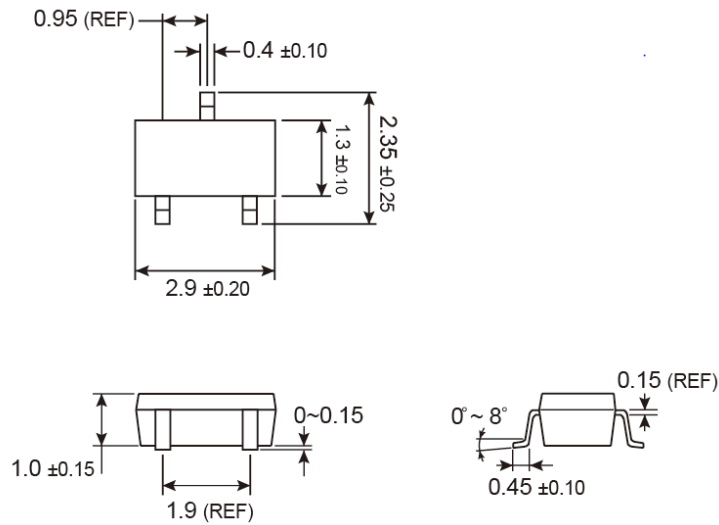
TEST CIRCUIT FOR CURVE A



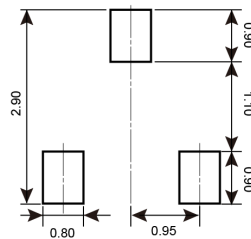
TEST CIRCUIT FOR CURVE B

**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)

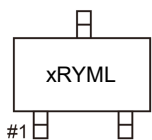
**SOT-23**



**SUGGESTED PAD LAYOUT** (Unit: Millimeters)



**MARKING DIAGRAM**



- xR** = Device code
  - A** = TS431A
  - B** = TS431B
- Y** = Year Code
- M** = Month Code for Halogen Free Product
  - O** =Jan    **P** =Feb    **Q** =Mar    **R** =Apr
  - S** =May    **T** =Jun    **U** =Jul    **V** =Aug
  - W** =Sep    **X** =Oct    **Y** =Nov    **Z** =Dec
- L** = Lot Code (1~9, A~Z)

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