

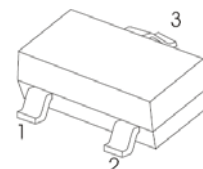
## DESCRIPTION

TL431 is an adjustable three-terminal shunt regulator with excellent thermal stability over operating temperature range. The output voltage can be set to any value between  $V_{ref}$  (approximately 2.5V) and 36V through external resistors. It provides a very sensitive turn-on characteristic, which makes it possible to replace Zener diodes in many applications.

## FEATURES

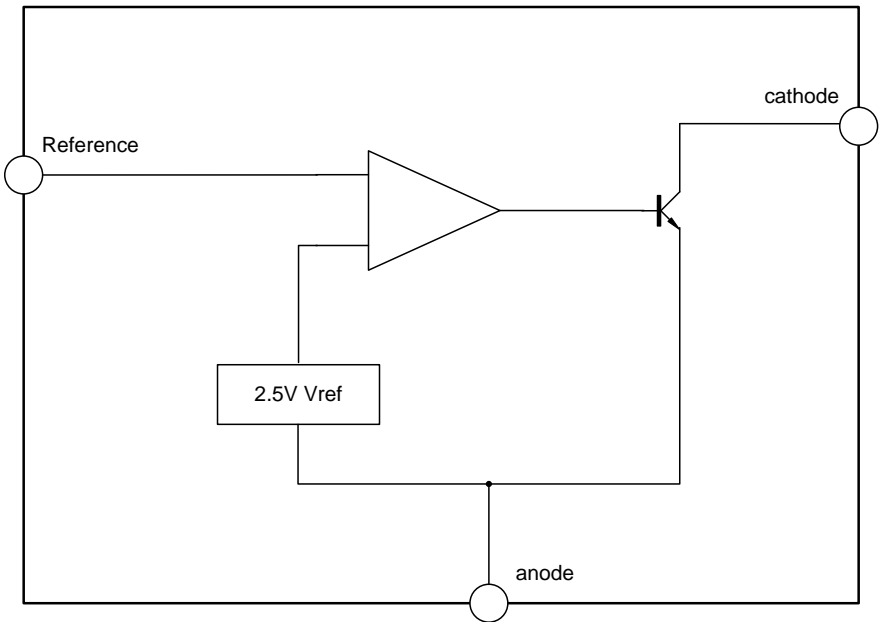
- ♦ Adjustable output voltage: up to 36V
- ♦ Low dynamic output impedance:  $0.3\Omega$
- ♦ Sink current capability: 1.0~100mA
- ♦ Equivalent full-scale temperature coefficient: typ. 50ppm/°C
- ♦ Temperature compensation in the rated operating temperature range
- ♦ Low output noise
- ♦ Fast start-up response

### SOT - 23



- 1 Cathode
- 2 Ref
- 3 Anode

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Characteristics	Symbol	Rating		Unit
Cathode voltage	$V_{KA}$	37		V
Cathode current (continuous)	$I_{KA}$	-100~+150		mA
Reference input current range	$I_{ref}$	0.05~+10		mA
Power dissipation	$P_D$	SOT-23	290	mW
Storage temperature range	$T_{stg}$	-65~+150		°C

RECOMMENDED OPERATING CONDITION

Characteristics	Symbol	Min.	Typ.	Max.	Unit
Cathode voltage	$V_{KA}$	$V_{REF}$	--	36	V
Cathode current	$I_{KA}$	1.0	--	100	mA
Operating temperature tange	$T_{opr}$	-40	--	125	°C

**ELECTRICAL CHARACTERISTICS (UNLESS OTHERWISE SPECIFIED,  $T_a$  -25°C)**

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Reference voltage	TL431BIDBZR	$V_{KA}=V_{REF}$ , $I_{KA}=10mA$	2.488	2.50	2.512	V
	TL431AIDBZR		2.475	2.50	2.525	
Deviation of reference input voltage over full temperature range (note 1)	$\Delta V_{ref}$	$V_{KA}=V_{REF}$ , $I_{KA}=10mA$ $T_{MIN} \leq T_A \leq T_{MAX}$	--	14	34	mV
Ratio of change in reference voltage to the change in cathode voltage	$\Delta V_{ref}/\Delta V_{KA}$	$I_{KA}=10mA$ $\Delta V_{KA}=10V \sim V_{REF}$	--	-1.0	-2.7	mV/V
		$\Delta V_{KA}=36V \sim 10V$	--	-0.5	-2.0	
Reference input current	$I_{ref}$	$I_{KA}=10mA$ , $R1=10k\Omega$ , $R2=\infty$	--	1.5	4	$\mu A$
Deviation of reference input current over full temperature range	$\Delta I_{ref}$	$I_{KA}=10mA$ , $R1=10k\Omega$ , $R2=\infty$ , $T_A$ =full Temperature	--	0.4	1.2	$\mu A$
Min. cathode current for regulation	$I_{KA(min)}$	$V_{KA}=V_{REF}$	--	0.45	1.0	mA
Off-state cathode current	$I_{KA(OFF)}$	$V_{KA}=36V$ , $V_{REF}=0$	--	0.05	1.0	$\mu A$
Dynamic impedance	$Z_{KA}$	$V_{KA}=V_{REF}$ , $I_{KA}=1$ to 100mA, $f \leq 1.0kHz$	--	0.3	0.5	$\Omega$

**Note 1:**  $T_{MIN}=-40^\circ C$ ,  $T_{MAX}=+125^\circ C$ .

## TYPICAL ELECTRICAL CHARACTERISTICS

Figure 1. Cathode Current vs. Cathode Voltage

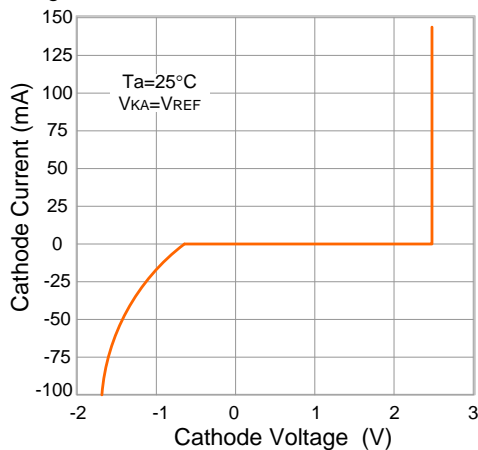


Figure 2. Cathode Current vs. Cathode Voltage

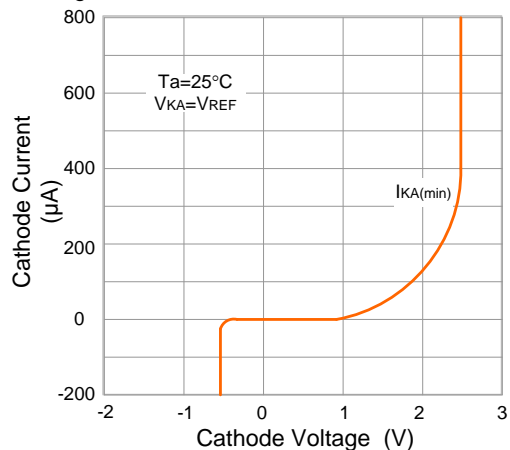


Figure 3. Reference Input voltage Change vs. Cathode Voltage

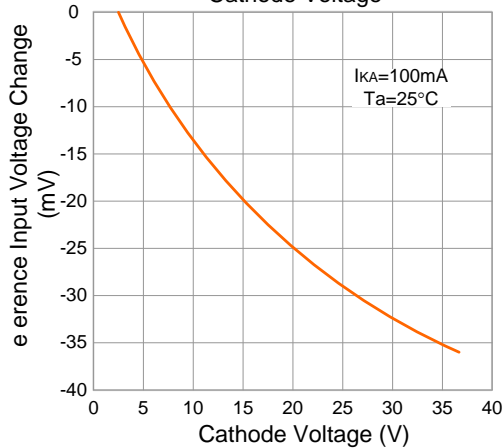


Figure 4. Pulse Response

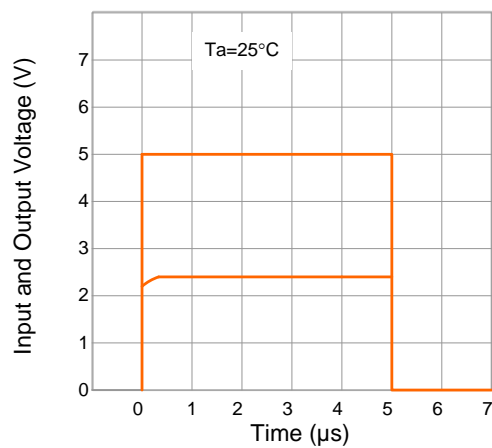


Figure 5. Dynamic Impedance vs. Frequency

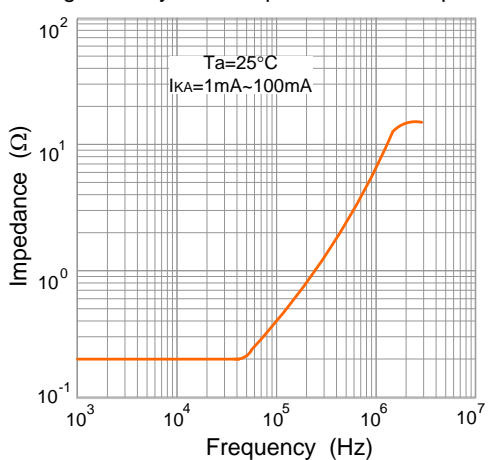
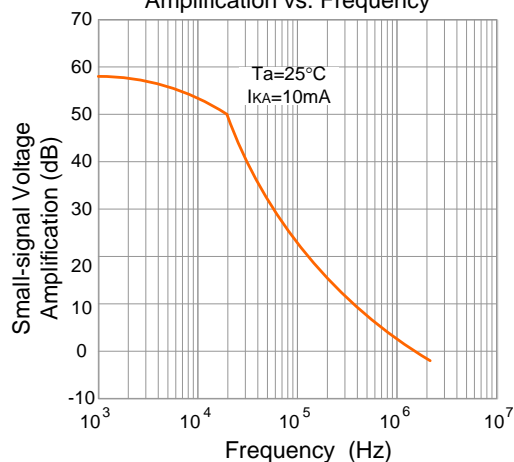
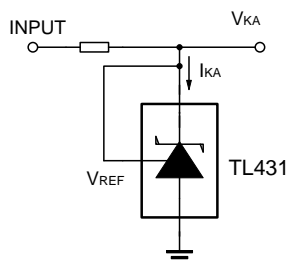


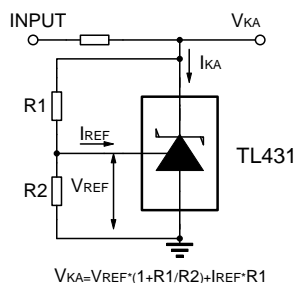
Figure 6. Small-signal Voltage Amplification vs. Frequency



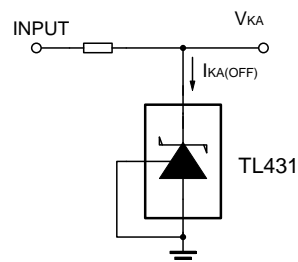
## TEST CIRCUITS



Test Circuit for  $V_{KA} = V_{REF}$

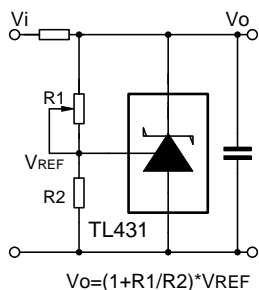


Test Circuit for  $V_{KA} \geq V_{REF}$

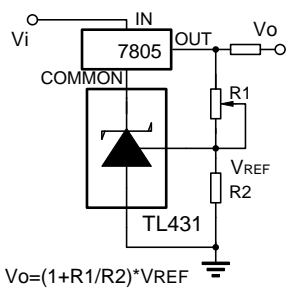


Test Circuit for  $I_{KA(OFF)}$

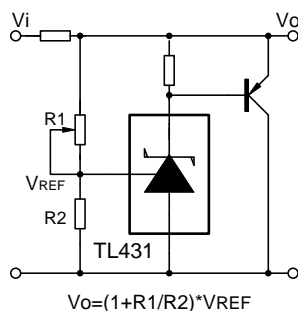
## TYPICAL APPLICATION CIRCUIT



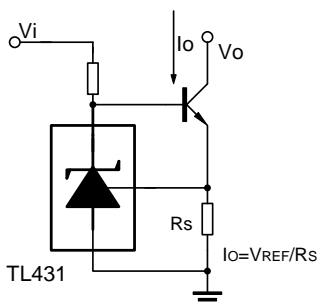
Shunt Regulator



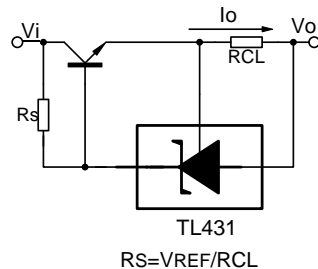
Three-terminal Fixed  
Regulator Output Control



High-current Shunt Regulator



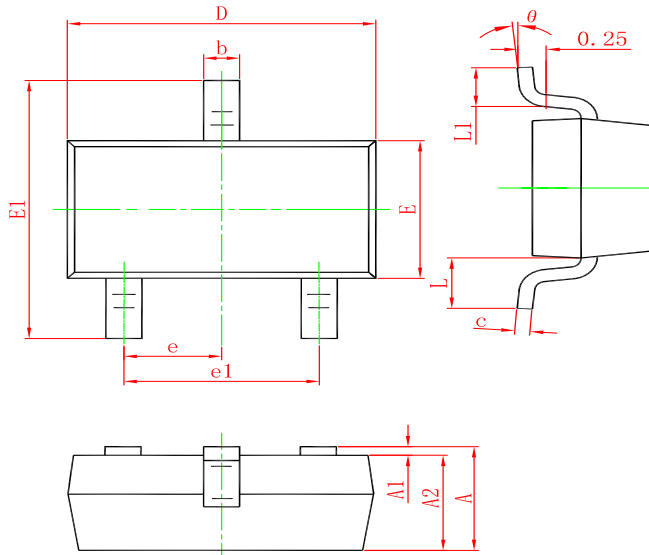
Constant Current Source



Current Limiter or Current Source

## PACKAGE OUTLINE

### SOT-23



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.900	1.150	0.035	0.045
A1	0.000	0.100	0.000	0.004
A2	0.900	1.050	0.035	0.041
b	0.300	0.500	0.012	0.020
c	0.080	0.150	0.003	0.006
D	2.800	3.000	0.110	0.118
E	1.200	1.400	0.047	0.055
E1	2.250	2.550	0.089	0.100
e	0.950 TYP.		0.037 TYP.	
e1	1.800	2.000	0.071	0.079
L	0.550 REF.		0.022 REF.	
L1	0.300	0.500	0.012	0.020
θ	0°	8°	0°	8°

## Ordering information

Order code	Package	Baseqty	Deliverymode	Accuracy	Marking
UMW TL431AIDBZR	SOT-23	3000	Tape and reel	1%	TA13 UMW
UMW TL431BIDBZR	SOT-23	3000	Tape and reel	0.5%	T3F3 UMW