

## Programmable Precision Shunt Regulator

### ● Features

- Low voltage operation ( 2.5V )
- Adjustable output voltage  $V_O = V_{REF}$  to 40V ( L 20V )
- Wide operating current range 120 $\mu$ A to 100mA
- Low dynamic output impedance 0.2 $\Omega$  typ.
- Trimmed bandgap design up to  $\pm 0.5\%$ .
- ESD rating is 5.5KV ( Per MIL-STD-883D ).

output circuitry provides a very sharp turn on characteristic, making this device excellent replacement for Zener diodes in many applications.

The TL431 series are characterized for operation from -40 $^{\circ}$ C to 125 $^{\circ}$ C and four package options ( SOT23, SOT89, SOP8 and TO92 ) allow the designer the opportunity to select the proper package for their applications.

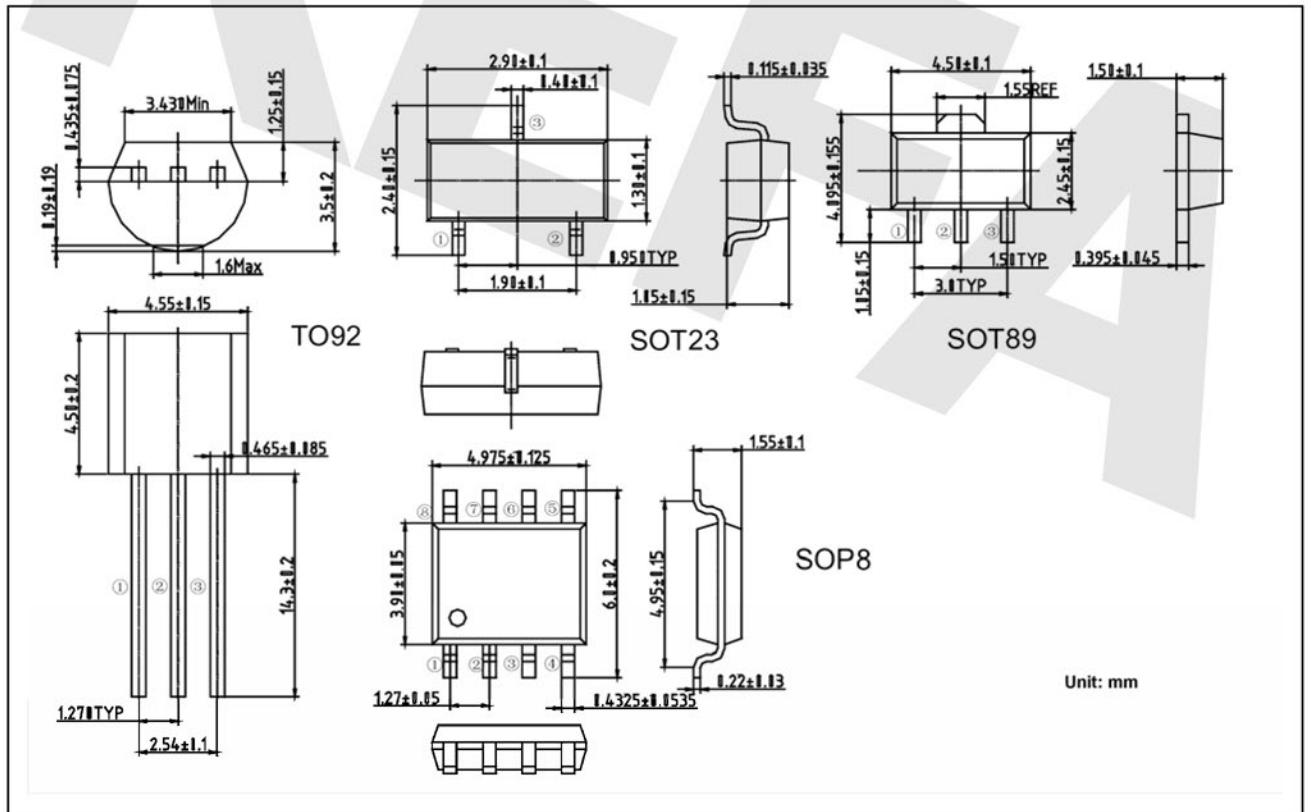
### ● General Description

The TL431 series are low voltage three terminal adjustable shunt regulator with a guaranteed thermal stability over applicable temperature ranges. The output voltage can be set to any value between  $V_{REF}$  ( approximately 2.5V ) to 40V ( L to 20V ) with two external resistors ( see application circuit ). This device has a typical output impedance of 0.2 $\Omega$ . Active

### ● Applications

- Linear Regulators
- Adjustable Supplies
- Switching Power Supplies
- Battery Operated Computers
- Instrumentation
- Computer Disk Drives

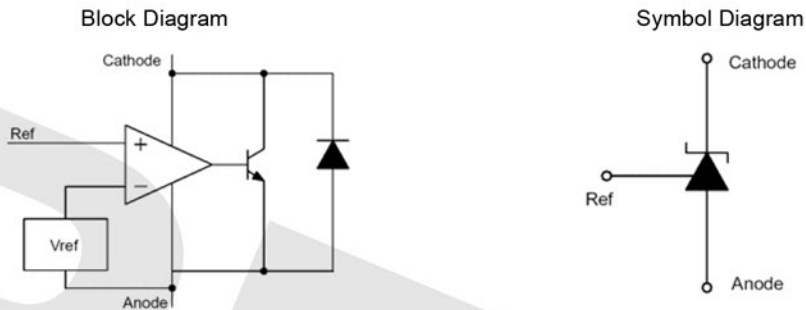
### ● Package Information



● Pin Configurations

Pin Port	SOT23	SOP8	SOT89	TO92
①	Reference	Cathode	Reference	Reference
②	Cathode	Anode	Cathode	Anode
③	Anode	Anode	Anode	Cathode
④⑤	--	NC	--	--
⑥⑦	--	Anode	--	--
⑧	--	Reference	--	--

● Functional Block Diagram



● Ordering Information

**TL431** -

Cathode Voltage: L=20V, H=40V  
 Output Voltage Tolerance: BC=0.5%, AC=1%, C=2%  
 Indicate the product number

● Absolute Maximum Ratings

( Operating temperature range applies unless otherwise specified. )

Parameter		Symbol	Maximum	Units
Cathode Voltage		TL431XXL	20	V
		TL431XXH	40	
Continuous Cathode Current		$I_{KA}$	150	mA
Reference Current		$I_{REF}$	10	mA
Power Dissipation $T_A=25^\circ\text{C}$	SOT23	$P_D$	150	mW
	SOP8		1000	
	SOT89		500	
	TO92		770	
Operating Temperature Range		$T_{OPR}$	-40 to +125	$^\circ\text{C}$
Junction Temperature		$T_J$	150	$^\circ\text{C}$
Storage Temperature Range		$T_{STG}$	-65 to +150	$^\circ\text{C}$
Lead Temperature (Soldering) 10 seconds		$T_{LEAD}$	260	$^\circ\text{C}$

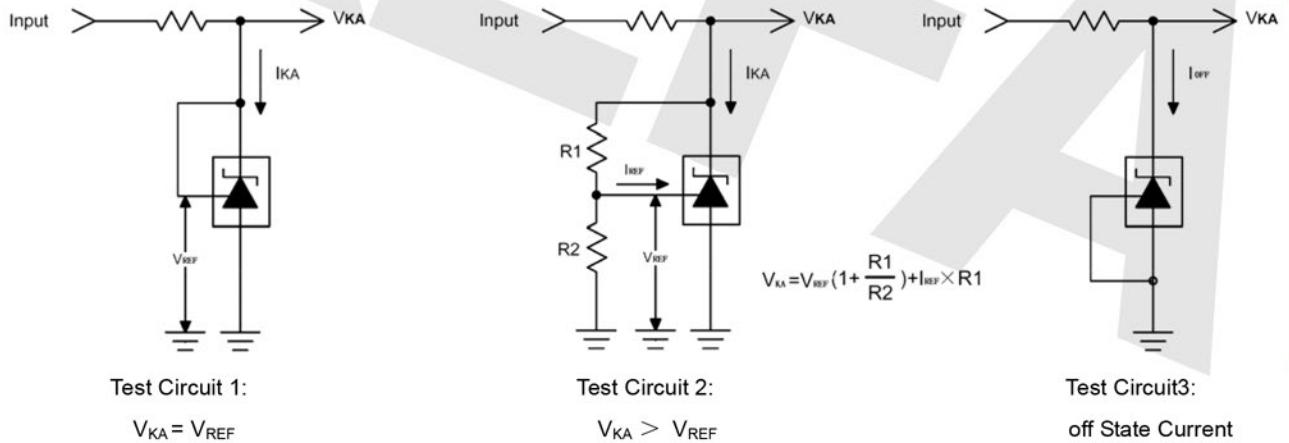
● **Electrical Characteristics**

( $T_A = +25^\circ\text{C}$ , unless otherwise specified)

Parameter	Symbol	Test Circuit	Test Condition	TL431			Unit
				Min	Typ	Max	
Reference voltage	$V_{REF}$	1	$V_{KA} = V_{REF}$ $I_{KA} = 10\text{mA}$	2482	2495	2507	mV
				2470	2495	2519	
				2445	2495	2544	
Deviation of reference voltage over full temperature range	$V_{I(DEV)}$	1	$V_{KA} = V_{REF}$ $I_{KA} = 10\text{mA}$ $T_A = \text{full range}^*$		4	25	mV
Ratio of change in reference voltage to the change in cathode voltage	$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	2	$I_{KA} = 10\text{mA}$ $\Delta V_{KA} = 10\text{V} - V_{REF}$		-1.4	-2.7	mV/V
Reference current	$I_{REF}$	2	$I_{KA} = 10\text{mA}, R1 = 10\text{K}, R2 = \infty$		2	4	$\mu\text{A}$
Deviation of reference current over full temperature range	$I_{I(DEV)}$	2	$I_{KA} = 10\text{mA}, R1 = 10\text{K}, R2 = \infty, T_A = \text{full range}$		0.4	1.2	$\mu\text{A}$
Minimum cathode current for regulation	$I_{MIN}$	1	$V_{KA} = V_{REF}$		0.2	1	mA
Off-state cathode current	$I_{OFF}$	3	$V_{KA} = 36\text{V}, V_{REF} = 0$		0.1	1	$\mu\text{A}$
Dynamic impedance	$R_Z$	1	$I_{KA} = 1\text{mA to } 100\text{mA}, V_{KA} = V_{REF}$ $F \leq 1\text{kHz}$		0.2	0.5	$\Omega$

\* Full range  $-40^\circ\text{C} \sim 125^\circ\text{C}$

Test Circuits



● **Typical Application Circuit**

