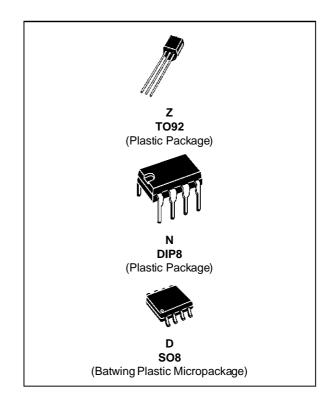


PROGRAMMABLE VOLTAGE REFERENCE

- ADJUSTABLE OUTPUT VOLTAGE : V_{ref} to 36V
- SINK CURRENT CAPABILITY: 1 to 100mA
 TYPICAL OUTPUT IMPEDANCE: 0.22Ω
- 1% AND 2% VOLTAGE PRECISION



DESCRIPTION

The TL431 is a programmable shunt voltage reference with guaranteed temperature stability over the entire temperature range of operation.

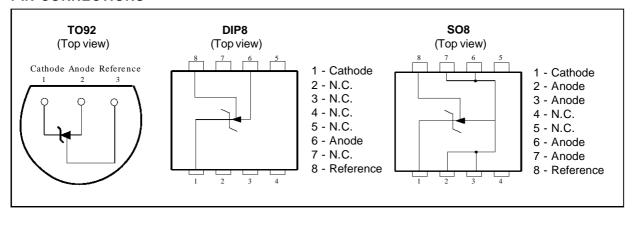
The output voltage may be set to any value between V_{ref} (approximately 2.5V) and 36V with two external resistors.

The TL431 operates with a wide current range from 1 to 100mA with a typical dynamic impedance of 0.22Ω .

ORDER CODES

Part number	Temperature	Р	ackag	е
i ait iidiiibei	Range	Z	D	
TL431C/AC	0°C, +70°C	•	•	•
TL431I/AI	-40°C, +85°C	•	•	•

PIN CONNECTIONS



November 1996 1/7

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit	
V_{KA}	Cathode to Anode Voltage	37	V	
I _K	Continuous Cathode Current Range	-100 to +150	mA	
I _{ref}	Reference Input Current Range		-0.05 to +10	mA
T _{oper}	Operating Free-air Temperature Range	TL431C/AC TL431I/AI	0 to +70 -40 to +85	°C
T _{stg}	Storage Temperature Range		-65 to +150	°C

OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V _{KA}	Cathode to Anode Voltage	V _{ref} to 36	V
I _K	Cathode Current	1 to 100	mA

ELECTRICAL CHARACTERISTICS

T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	TL431C			1	Unit		
Зуппоог	raiailietei	Min.	Тур.	Max.	Min.	Тур.	Max.	Unit
V_{ref}	$ \begin{array}{c} \text{Reference Input Voltage - (figure 1)} \\ V_{KA} = V_{ref}, \ I_{K} = 10 \text{mA} & T_{amb} = 25^{\circ}\text{C} \\ T_{min.} \leq T_{amb} \leq T_{max}. \end{array} $	2.44 2.423	2.495	2.55 2.567	2.47 2.453	2.495	2.52 2.537	V
ΔV_{ref}	Reference Input Voltage Deviation Over Temperature Range - (figure 1, note1) $V_{KA} = V_{ref,\ l_K} = 10mA,\ T_{min.} \le T_{amb} \le T_{max.}$		3	17		3	15	mV
$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	Ratio of Change in Reference Input Voltage to Change in Cathode to Anode Voltage - (figure 2) $I_{K} = 10 \text{mA}$ $\Delta V_{KA} = 10 \text{V to } V_{\text{ref}}$ $\Delta V_{KA} = 36 \text{V to } 10 \text{V}$		-1.4 -1	-2.7 -2		-1.4 -1	-2.7 -2	mV/V
Iref	Reference Input Current - (figure 2) $I_{K} = 10mA, \ R_{1} = 10k\Omega, \ R_{2} = \infty \\ T_{amb} = 25^{o}C \\ T_{min.} \leq T_{amb} \leq T_{max.}$		1.8	4 5.2		1.8	4 5.2	μА
ΔI_{ref}	Reference Input Current Deviation Over Temperature Range - (figure 2) $I_{K} = 10mA, \ R_{1} = 10k\Omega, \ R_{2} = \infty \\ T_{min.} \leq T_{amb} \leq T_{max}.$		0.4	1.2		0.4	1.2	μА
I _{min}			0.5	1		0.5	0.6	mA
l _{off}	Off-State Cathode Current - (figure 3)		2.6	1000		2.6	1000	nA
Z _{KA}	Dynamic Impedance - (figure 1, note 2) $V_{KA} = V_{ref}, \Delta I_K = 1 \text{ to } 100\text{mA}, f \leq 1\text{kHz}$		0.22	0.5		0.22	0.5	Ω

Notes : 1. ΔV_{ref} is defined as the difference between the maximum and minimum values obtained over the full temperature range.

range. $\Delta V_{ref} = V_{ref max.} - V_{ref min}$ $V_{ref min.}$ $V_{ref min.}$ T1 T2Temperation

2. The dynamic Impedance is defined as $|Z_{\text{KA}}| = \frac{\Delta V_{\text{KA}}}{\Delta l_{\text{K}}}$

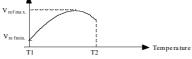
ELECTRICAL CHARACTERISTICS

 $T_{amb} = 25^{\circ}C$ (unless otherwise specified)

Symbol	Parameter	TL431I Min. Typ. Max.			I TL431AI			
Syllibol	Faranteter				Min.	Тур.	Max.	Unit
V_{ref}	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	2.44 2.41	2.495	2.55 2.58	2.47 2.44	2.495	2.52 2.55	V
ΔV_{ref}	Reference Input Voltage Deviation Over Temperature Range - (figure 1, note1) $V_{KA} = V_{ref}, \ I_{K} = 10 mA, \ T_{min.} \leq T_{amb} \leq T_{max.}$		7	30		7	17	mV
$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	Ratio of Change in Reference Input Voltage to Change in Cathode to Anode Voltage - (figure 2) $I_{K} = 10\text{mA} \qquad \qquad \Delta V_{KA} = 10\text{V to } V_{ref} \\ \Delta V_{KA} = 36\text{V to } 10\text{V}$		-1.4 -1	-2.7 -2		-1.4 -1	-2.7 -2	mV/V
Iref	Reference Input Current - (figure 2) $ \begin{aligned} \text{I}_{\text{K}} &= 10\text{mA}, \ \text{R}_1 = 10\text{k}\Omega, \ \text{R}_2 = \infty \\ & T_{amb} = 25^{\circ}\text{C} \\ & T_{min.} \leq T_{amb} \leq T_{max}. \end{aligned} $		1.8	4 6.5		1.8	4 6.5	μА
ΔI_{ref}	Reference Input Current Deviation Over Temperature Range - (figure 2) $I_K = 10 \text{mA}, \ R_1 = 10 \text{k}\Omega, \ R_2 = \infty \\ T_{min.} \leq T_{amb} \leq T_{max}.$		0.8	2.5		0.8	1.2	μА
I _{min}			0.5	1		0.5	0.7	mA
l _{off}	Off-State Cathode Current - (figure 3)		2.6	1000		2.6	1000	nA
Z _{KA}	Dynamic Impedance - (figure 1, note 2) $V_{KA} = V_{ref}$, $\Delta I_K = 1$ to 100mA, $f \le 1$ kHz		0.22	0.5		0.22	0.5	Ω

Notes : 1. ΔV_{ref} is defined as the difference between the maximum and minimum values obtained over the full temperature range.

 $\Delta V_{ref} = V_{ref max.} - V_{ref min}$



2. The dynamic Impedance is defined as $|Z_{KA}| = \frac{\Delta V_{KA}}{\Delta I_{K}}$

Figure 1 : Test Circuit for $V_{KA} = V_{ref}$

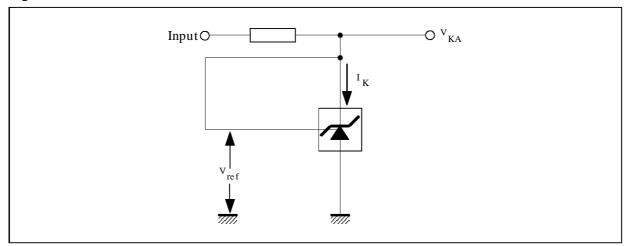


Figure 2 : Test Circuit for $V_{KA} > V_{ref}$

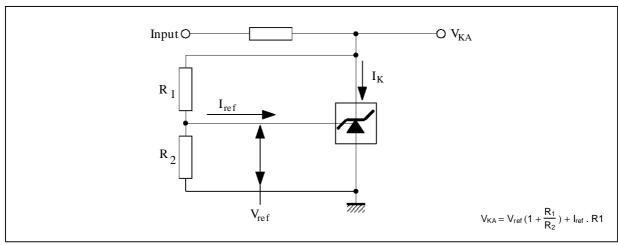
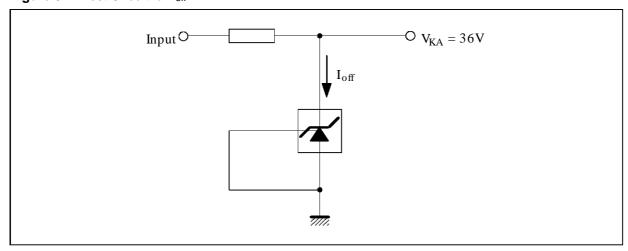
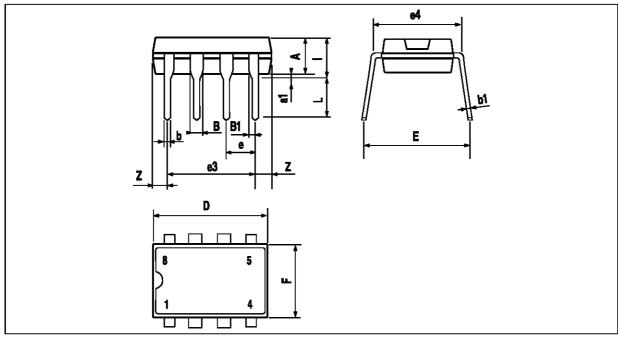


Figure 3: Test Circuit for Ioff



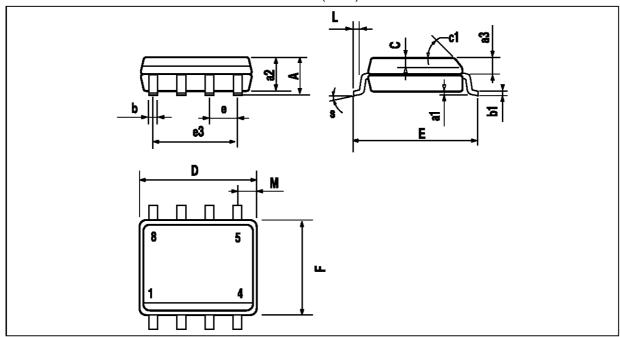
PACKAGE MECHANICAL DATA 8 PINS - PLASTIC DIP



Dim.		Millimeters			Inches	
Diiii.	Min.	Тур.	Max.	Min.	Тур.	Max.
Α		3.32			0.131	
a1	0.51			0.020		
В	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
Е	7.95		9.75	0.313		0.384
е		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

PACKAGE MECHANICAL DATA

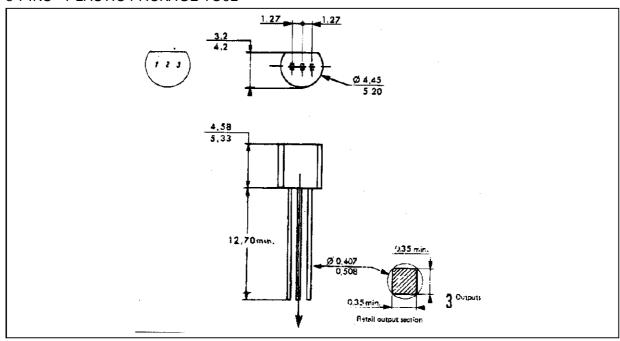
8 PINS - BATWING PLASTIC MICROPACKAGE (SO8)



Dimensions		Millimeters			Inches			
Dimensions	Min.	Тур.	Max.	Min.	Тур.	Max.		
Α			1.75			0.069		
a1	0.1		0.25	0.004		0.010		
a2			1.65			0.065		
а3	0.65		0.85	0.026		0.033		
b	0.35		0.48	0.014		0.019		
b1	0.19		0.25	0.007		0.010		
С	0.25		0.5	0.010		0.020		
c1			45°	(typ.)				
D	4.8		5.0	0.189		0.197		
E	5.8		6.2	0.228		0.244		
е		1.27			0.050			
e3		3.81			0.150			
F	3.8		4.0	0.150		0.157		
L	0.4		1.27	0.016		0.050		
М			0.6			0.024		
S	8° (max.)							

PACKAGE MECHANICAL DATA

3 PINS - PLASTIC PACKAGE TO92



Dimensions		Millimeters			Inches	
	Min.	Тур.	Max.	Min.	Тур.	Max.
L		1.27			0.05	
В	3.2	3.7	4.2	0.126	0.1457	0.1654
01	4.45	5.00	5.2	0.1752	0.1969	0.2047
С	4.58	5.03	5.33	0.1803	0.198	0.2098
K	12.7			0.5		
O2	0.407	0.5	0.508	0.016	0.0197	0.02
а	0.35			0.0138		

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