



Adjustable Voltage Reference – TL431

Rev 1.0
02/05/20

Precision programmable Shunt Voltage Reference in bare die form

Description

The TL431 three-terminal shunt reference combines low temperature co-efficient zener band-gap regulation with programmability. The device operates over a wide 1mA to 100mA current range with voltage adjustable from V_{REF} (2.5V) to 36V, set via x2 external resistors. With high temperature stability and typical dynamic impedance of 0.27Ω , these references make excellent replacements for zener diodes in many high reliability applications. By default, the 2.5V V_{REF} provides a stable reference from 5V logic supplies. The device is simple to implement, highly reliable and can be used as either positive or negative reference.

Features:

- Programmable output voltage to 36V
- $\pm 0.5\%$ reference voltage tolerance at 25°C
- Low dynamic output impedance: 0.27Ω Typ
- Sink current capability: 1mA to 100 mA
- Band-gap reference corrects temperature drift
- Full military temperature range
- Smaller die size than industry peers

Ordering Information

The following part suffixes apply:

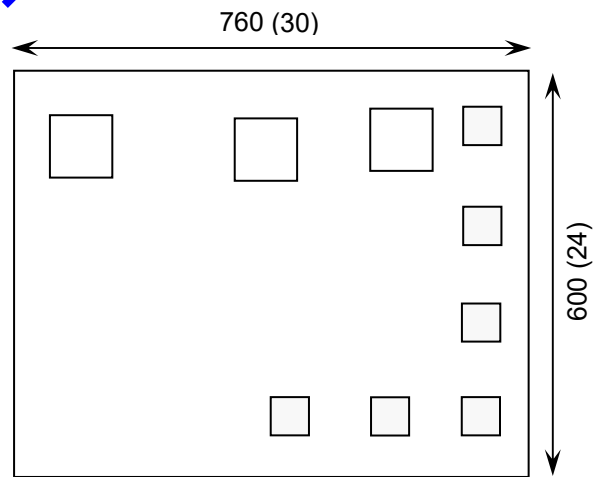
- No suffix - MIL-STD-883 /2010B Visual Inspection
- "H" - MIL-STD-883 /2010B Visual Inspection + MIL-PRF-38534 Class H LAT
- "K" - MIL-STD-883 /2010A Visual Inspection (Space) + MIL-PRF-38534 Class K LAT

LAT = Lot Acceptance Test.

For further information on LAT process flows see below.

www.siliconsupplies.com/quality/bare-die-lot-qualification

Die Dimensions in μm (mils)



Supply Formats:

- Default - Die in Waffle Pack (400 per tray capacity)
- Sawn Wafer on Tape – On request
- Unsawn Wafer – On request
- Die Thickness \leftrightarrow 280 μm (11 Mils) – On request
- In Metal or Ceramic package – On request

Mechanical Specification

Die Size (Unsawn)	760 x 600 30 x 24	μm mils
Minimum Bond Pad Size	92 x 92 3.62 x 3.62	μm mils
Die Thickness	280 (± 20) 11 (± 0.8)	μm mils
Top Metal Composition	Al 1%Si 1.4 μm	
Back Metal Composition	N/A – Bare Si	

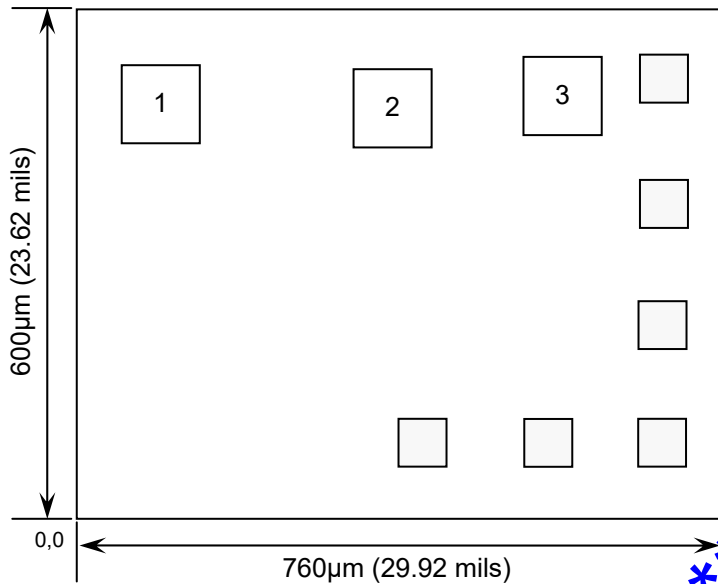




Adjustable Voltage Reference – TL431

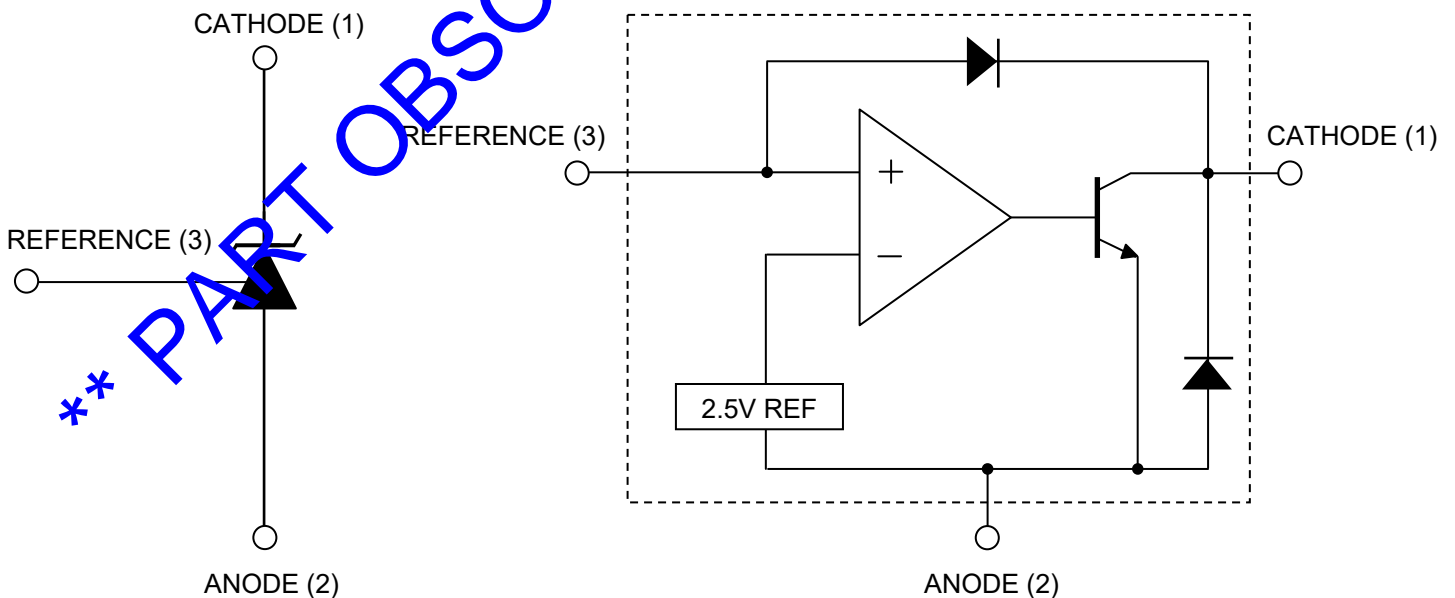
Rev 1.0
02/05/20

Pad Layout and Functions



PAD	FUNCTION	COORDINATES (µm)	
		X	Y
1	CATHODE	53	442
2	ANODE	325	437
3	REFERENCE	525	450
CONNECT CHIP BACK TO ANODE			

Symbol & functional block diagram





Adjustable Voltage Reference – TL431

Rev 1.0

02/05/20

Absolute Maximum Ratings¹ $T_A = 25^\circ\text{C}$ unless otherwise stated

PARAMETER	SYMBOL	VALUE	UNIT
Cathode to Anode Voltage	V_{KA}	40	V
Cathode Current Range, Continuous	I_K	-100 to +150	mA
Reference Input Current Range, Continuous	I_{REF}	-0.05 to 10	mA
Operating Junction Temperature Range	T_J	150	$^\circ\text{C}$
Storage Temperature	T_{STG}	-65 to 150	$^\circ\text{C}$

1. Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.

Recommended Operating Conditions

PARAMETER	SYMBOL	MIN	MAX	UNIT
Cathode Voltage	V_{KA}	0.06	36	V
Cathode Current	I_K	-0.5	100	mA
Ambient Operating Temperature Range	T_A	-55 to 125		$^\circ\text{C}$

Electrical Characteristics, $T_A = 25^\circ\text{C}$, $V_{KA} = V_{REF}$, $I_K = 10\text{mA}$ unless otherwise stated

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Reference input voltage	V_{REF}	$V_{KA} = V_{REF}$, $I_K = 10\text{mA}$	2.483	2.495	2.507	V
Reference input voltage, Deviation over temperature range	ΔV_{REF}	$V_{KA} = V_{REF}$, $I_K = 10\text{mA}$, $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	-	14	34	mV
Ratio of change in reference input voltage to change in cathode to anode voltage	$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	$I_K = 10\text{mA}$, $\Delta V_{KA} = 10\text{V to } V_{REF}$	-0.4	-	-2.7	mV/V
		$I_K = 10\text{mA}$, $\Delta V_{KA} = 36\text{V to } 10\text{V}$	-0.4	-	-2.0	
Reference input current	I_{REF}	$I_K = 10\text{mA}$, $R1 = 10\text{k}\Omega$, $R2 = \infty$	-	1.8	4	μA
		$I_K = 10\text{mA}$, $R1 = 10\text{k}\Omega$, $R2 = \infty$, $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$	-	-	6.5	
Reference input current, Deviation over temperature range	ΔI_{REF}	$I_K = 10\text{mA}$, $R1 = 10\text{k}\Omega$, $R2 = \infty$	-	0.8	2.5	μA
Minimum cathode current for regulation	$I_{K(MIN)}$	$V_{KA} = V_{REF}$		0.25	0.5	mA
Off-State cathode current	$I_{K(OFF)}$	$V_{KA} = 36\text{V}$, $V_{REF} = 0\text{V}$	-	20	1000	nA
Dynamic impedance	$ Z_{KA} $	$I_K = 10\text{mA to } 100\text{mA}$, $f \leq 1.0\text{KHz}$	-	0.27	0.5	Ω





Adjustable Voltage Reference – TL431

Rev 1.0
02/05/20

Test Circuits

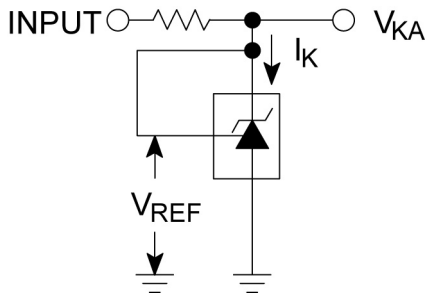


FIGURE 1. $V_{KA} = V_{REF}$

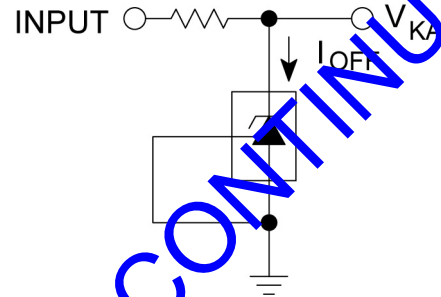
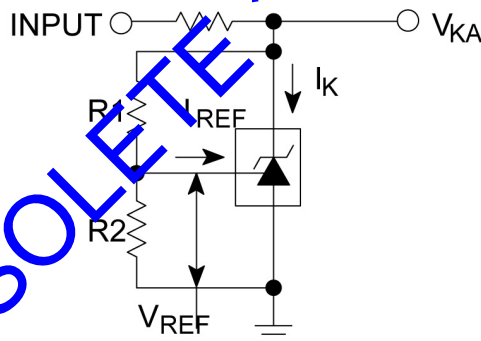


FIGURE 2. I_{OFF}



$$V_{KA} = V_{REF} \left(1 + \frac{R1}{R2} \right) + I_{REF} \cdot R1$$

FIGURE 3. $V_{KA} > V_{REF}$

DISCLAIMER: The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Silicon Supplies Ltd hereby disclaims any and all warranties and liabilities of any kind.

LIFE SUPPORT POLICY: Silicon Supplies Ltd components may be used in life support devices or systems only with the express written approval of Silicon Supplies Ltd, if a failure of such components can reasonably be expected to cause the failure of that life support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

