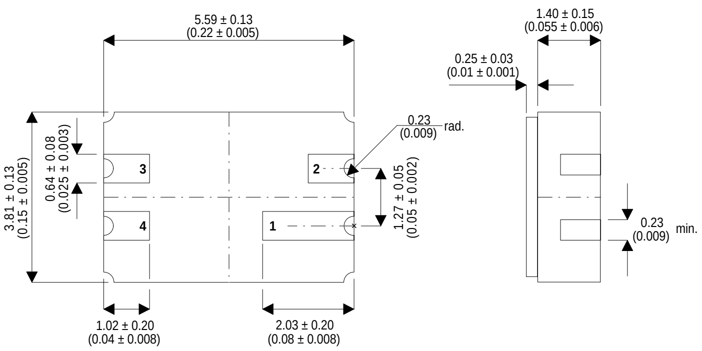
IP431CSM4



LCC3 HERMETICALLY SEALED CERAMIC SURFACE MOUNT PACKAGE

PIN 1 - NOT CONNECTED
PIN 2 - CATHODE
PIN 3 - REFERENCE
PIN 4 - ANODE

PART NUMBER	AMBIENT TEMP. RANGE
IP431CSM4	-55 TO +125°C

PROGRAMMABLE PRECISION REFERENCE

FEATURES

- VOLTAGE REFERENCE TOLERANCE ±1%
- PROGRAMMABLE OUTPUT VOLTAGE TO 36V
- EQUIVALENT FULL RANGE TEMPERATURE COEFFICIENT OF 30ppm/°C TYPICAL
- TEMPERATURE COMPENSATED FOR OPERATION OVER FULL RATED OPERATING TEMPERATURE RANGE
- SINK CURRENT CAPABILITY 1 TO 100 mA
- FAST TURN–ON RESPONSE
- LOW DYNAMIC OUTPUT IMPEDANCE (0.2Ω typical)
- LOW OUTPUT NOISE VOLTAGE

ABSOLUTE MAXIMUM RATINGS (T_{case} = 25°C unless otherwise stated)

V_{KA}	Cathode To Anode Voltage		37V
I_K	Cathode Current Range		-100 to +150mA
I_{REF}	Reference Input Current Range		-0.05 to +10mA
P_D	Power Dissipation @ T_A = 25°C	CSM4 Package	0.80W
	Derate Above 25°C		6.4W/°C
T_J	Maximum Operating Junction Temperature		150°C
T_A	Operating Ambient Temperature Range		See Table Above
T_{STG}	Storage Temperature Range		–65 to 150°C

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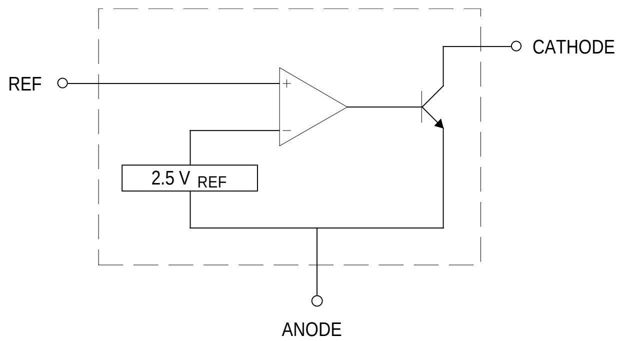
IP431CSM4

DESCRIPTION

The IP431A circuit is a monolithic three terminal programmable shunt regulator diode. The voltage reference operates as a low temperature coefficient zener which is programmable between V_{REF} (2.5V) and 36 volts using two external resistors. The device has a wide operating current range of 1 mA to 100mA and a typical dynamic impedance of 0.2Ω. Active output circuitry provides a very sharp turn-on characteristic making these devices excellent replacements for zener diodes in many applications. Being a shunt regulator it can be used as either a positive or negative voltage reference.

BLOCK DIAGRAM



RECOMMENDED OPERATING CONDITIONS

V_{KA}	Cathode To Anode Voltage	V_{REF} to 36V
I_K	Cathode Current Range	1.0 to 100mA

ELECTRICAL CHARACTERISTICS (T_A = 25 °C unless otherwise stated)

	Parameter		Test Conditions		IP431AM Min.	IP431AM Typ.	IP431AM Max.	Units
V_{REF}	Reference Input Voltage	(Figure 1)	$V_{KA} = V_{REF}$		2.47	2.495	2.52	V
			I_K = 10mA	T_A = -55 to +125°C *	2.426		2.564	
ΔV_{REF}	Reference Input Voltage Over Temperature Range [1]	(Figure 1)	$V_{KA} = V_{REF}$, I_K = 10mA	T_A = -55 to +125°C *		15	44	mV
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of Reference Voltage Change to Change in Cathode to Anode Voltage	(Figure 2)	I_K = 10mA	ΔV_{KA} = 10V to V_{REF}		-1.5	-2.7	mV/V
				ΔV_{KA} = 36V to 10V		-0.7	-2	
I_{REF}	Reference Input Current	(Figure 2)	R1 = 10kΩ	R2 = ∞		1	4	µA
			I_K = 10mA	T_A = -55 to +125°C *			7	
ΔI_{REF}	Reference Input Current Deviation Over Temperature Range	(Figure 2)	R1 = 10kΩ, I_K = 10mA	R2 = ∞, T_A = -55 to +125°C *		1	3	µA
I_{MIN}	Minimum Cathode Current For Regulation	(Figure 1)	$V_{KA} = V_{REF}$			0.5	1	mA
I_{OFF}	Off–State Cathode Current	(Figure 3)	V_{KA} = 36V	V_{REF} = 0		3	1000	nA
$\lvert Z_{ka}\rvert$	Dynamic Impedance [2]	(Figure 1)	$V_{KA} = V_{REF}$, ΔI_K = 1mA to 100mA	f ≤ 1kHz		0.2	0.5	Ω

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ELECTRICAL CHARACTERISTICS (T_A = 25 °C unless otherwise stated)

	Parameter		Test Conditions		IP431AI Min.	IP431AI Typ.	IP431AI Max.	Units
V_{REF}	Reference Input Voltage	(Figure 1)	$V_{KA} = V_{REF}$		2.47	2.495	2.52	V
			I_K = 10mA	T_A = -40 to +85°C *	2.44		2.55	
ΔV_{REF}	Reference Input Voltage Over Temperature Range [1]	(Figure 1)	$V_{KA} = V_{REF}$, I_K = 10mA	T_A = -40 to +85°C *		7	30	mV
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of Reference Voltage Change to Change in Cathode to Anode Voltage	(Figure 2)	I_K = 10mA	ΔV_{KA} = 10V to V_{REF}		-1.5	-2.7	mV/V
				ΔV_{KA} = 36V to 10V		-0.7	-2	
I_{REF}	Reference Input Current	(Figure 2)	R1 = 10kΩ	R2 = ∞		1	4	µA
			I_K = 10mA	T_A = -40 to +85°C *			6.5	
ΔI_{REF}	Reference Input Current Deviation Over Temperature Range	(Figure 2)	R1 = 10kΩ, I_K = 10mA	R2 = ∞, T_A = -40 to +85°C *		0.8	2.5	µA
I_{MIN}	Minimum Cathode Current For Regulation	(Figure 1)	$V_{KA} = V_{REF}$			0.5	1	mA
I_{OFF}	Off–State Cathode Current	(Figure 3)	V_{KA} = 36V	V_{REF} = 0		3	1000	nA
$\|Z_{ka}\|$	Dynamic Impedance [2]	(Figure 1)	$V_{KA} = V_{REF}$, ΔI_K = 1mA to 100mA	f ≤ 1kHz		0.2	0.5	Ω

	Parameter		Test Conditions		IP431AC Min.	IP431AC Typ.	IP431AC Max.	Units
V_{REF}	Reference Input Voltage	(Figure 1)	$V_{KA} = V_{REF}$		2.47	2.495	2.52	V
			I_K = 10mA	T_A = 0 to +70°C *	2.453		2.537	
ΔV_{REF}	Reference Input Voltage Over Temperature Range [1]	(Figure 1)	$V_{KA} = V_{REF}$, I_K = 10mA	T_A = 0 to +70°C *		3	17	mV
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio of Reference Voltage Change to Change in Cathode to Anode Voltage	(Figure 2)	I_K = 10mA	ΔV_{KA} = 10V to V_{REF}		-1.5	-2.7	mV/V
				ΔV_{KA} = 36V to 10V		-0.7	-2	
I_{REF}	Reference Input Current	(Figure 2)	R1 = 10kΩ	R2 = ∞		1	4	µA
			I_K = 10mA	T_A = 0 to +70°C *			5.2	
ΔI_{REF}	Reference Input Current Deviation Over Temperature Range	(Figure 2)	R1 = 10kΩ, I_K = 10mA	R2 = ∞, T_A = 0 to +70°C *		0.4	1.2	µA
I_{MIN}	Minimum Cathode Current For Regulation	(Figure 1)	$V_{KA} = V_{REF}$			0.5	1	mA
I_{OFF}	Off–State Cathode Current	(Figure 3)	V_{KA} = 36V	V_{REF} = 0		3	1000	nA
$\|Z_{ka}\|$	Dynamic Impedance [2]	(Figure 1)	$V_{KA} = V_{REF}$, ΔI_K = 1mA to 100mA	f ≤ 1kHz		0.2	0.5	Ω

FIGURE 1

TEST CIRCUIT FOR $V_{KA} = V_{REF}$

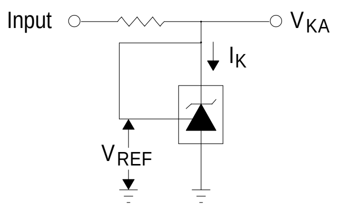
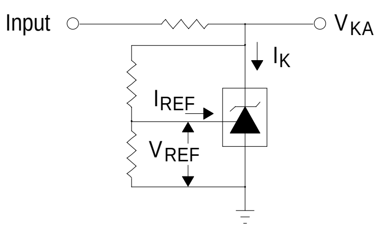


FIGURE 2

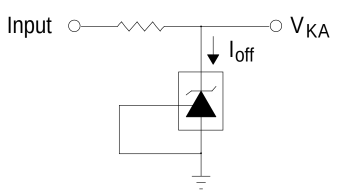
TEST CIRCUIT FOR $V_{KA} > V_{REF}$



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

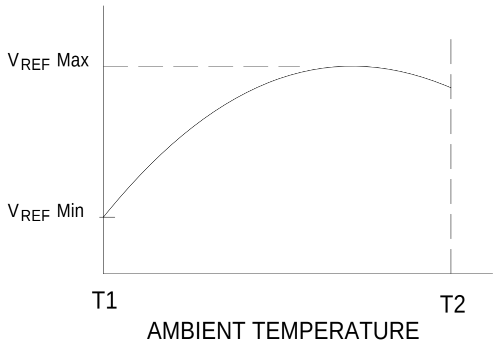
FIGURE 3

TEST CIRCUIT FOR I_{off}



NOTE 1

The deviation parameter ΔV_{REF} is defined as the differences between the maximum and minimum values obtained over the full operating ambient temperature range that applies.



$\Delta V_{REF} = V_{REF}$ Max - V_{REF} Min

$\Delta T_A = T2 - T1$

The average temperature coefficient of the reference input voltage, $\propto V_{REF}$ is defined as:

$$\propto V_{REF} = \frac{ppm}{°C} = \frac{\left(\frac{\Delta V_{REF}}{V_{REF}\ @\ 25°C}\right) \times 10^6}{\Delta T_A} = \frac{\Delta V_{REF} \times 10^6}{\Delta T_A\ (V_{REF}\ @\ 25°C)}$$

$\propto V_{REF}$ can be positive or negative depending on whether $\propto V_{REF}$ Min or $\propto V_{REF}$ Max occurs at the lower ambient temperature.

Example: $\Delta V_{REF} = 8.0$ mV and slope is positive,
V_{REF} @ 25°C = 2.495V, $\Delta T_A = 70°C$

$$\propto V_{REF} = \frac{0.008 \times 10^6 = 45.8\ ppm/°C}{70\ (2.495)} = 45.8\ ppm/°C$$

NOTE 2

The dynamic impedance Z_{ka} is defined as:

$$|Z_{ka}| = \frac{\Delta V_{KA}}{\Delta I_K}$$

When the device is programmed with two external resistors, R1 and R2, (refer to Figure 2) the total dynamic impedance of the circuit is defined as:

$$|Z_{ka}| \approx |Z_{ka}|\left(1+\frac{R1}{R2}\right)$$