PROGRAMMABLE PRECISION VOLTAGE REFERENCE

SILVR431371C3

Features:

- Voltage Reference Tolerance ±1%
- Programmable VREF To 36V
- Equivalent Full Range Temperature Coefficient Of 50ppm/°C Typical
- Temperature Compensated For Operation Over Full Rated Operating Temperature Range
- Sink Current Capability 1.0mA To 100mA
- Low Dynamic Output Impedance (0.22Ω Typical)
- Hermetic Ceramic Surface Mount Package (MO-041BA)

Description:

The SILVR431371C3 is a monolithic three terminal programmable shunt regulator diode. The voltage reference operates as a low temperature coefficient Zener which is programmable between VREF (2.5V) and 36V using two external resistors. The device has a wide operating current range of 1mA to 100mA and a typical dynamic impedance of 0.22Ω. Active output circuitry provides a very sharp turn-on characteristic making these devices excellent replacements for Zener diode in many applications. Being a shunt regulator it can be used as either a positive or negative voltage reference.

Applications:

Application include digital voltmeters, power supplies, and operational amplifier circuitry.

Absolute Maximum Ratings (T_A = 25°C unless otherwise noted)

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 (1)	Power Dissipation @ T_{SP} = 25°C	1.25W
	Derate Above 25°C	12.5mW/°C
T_J	Operating Junction Temperature Range	-55°C to +125°C
T_{STG}	Storage Temperature Range	-65°C to +150°C

Recommended Operating Conditions

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

ESD Rating

SYMBOL	RATING	VALUE	UNIT
HBM	Human Body Model Per JEDEC JESD22-A114F(2)	>2000	V
MM	Machine Model Per JEDEC JESD22-A115C(2)	>200	
CDM	Charged Device Model Per JEDEC JESD22-C101E(2)	>500	

Thermal Properties

SYMBOL	PARAMETER	MAX	UNITS
$R_{\theta SP}$	Thermal Resistance, Junction To Solder Pad	80	°C/W

Notes:

(1) Package Limited To Not Exceed T_J(MAX)

(2) By Design, Not A Production Test.

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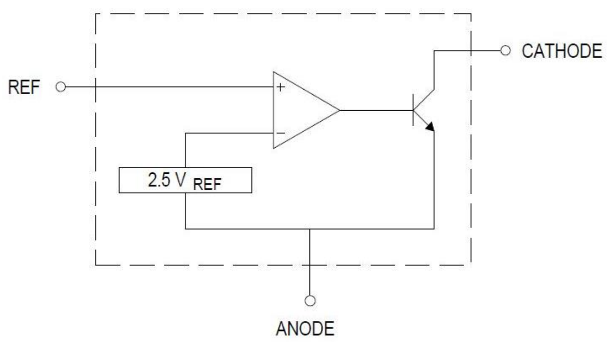
Electrical Specifications

Electrical characteristics (T_A = 25°C unless otherwise stated)

SYMBOLS	PARAMETERS	TEST CONDITIONS		MIN.	TYP.	MAX.	UNITS
V_{REF}	Reference Input Voltage	$V_{KA} = V_{REF}$		2.47	2.495	2.52	V
		I_K = 10mA	T_A = -55°C to +125°C	2.426		2.564	
ΔV_{REF}[2]	Reference Input Voltage Over Temperature Range	$V_{KA} = V_{REF}$ I_K = 10mA	T_A = -55°C to +125°C		7	44	mV
$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	Ratio Of Reference Voltage Change To Change In Cathode To Anode Voltage	I_K = 10mA	ΔV_{KA} = 10V to V_{REF}		-1.4	-2.7	$\frac{mV}{V}$
			ΔV_{KA} = 36V to 10V		-1.0	-2	
I_{REF}	Reference Input Current	R_1 = 10kΩ	$R_2 = \infty$		1.8	4	μA
		I_K = 10mA	T_A = -55°C to +125°C			7	
ΔI_{REF}[2]	Reference Input Current Deviation Over Temperature Range	R_1 = 10kΩ I_K = 10mA	$R_2 = \infty$ T_A = -55°C to +125°C		0.8	3	μA
I_{MIN}	Minimum Cathode Current For Regulation	$V_{KA} = V_{REF}$			0.5	1.0	mA
I_{OFF}	Off-State Cathode Current	V_{KA} = 36V	V_{REF} = 0		20	1000	nA
$\lvert Z_{ka} \rvert$	Dynamic Impedance	$V_{KA} = V_{REF}$ ΔI_K = 1mA to 100mA	f ≤ 1kHz		0.22	0.5	Ω

BLOCK DIAGRAM



Test Circuits

FIGURE 1

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

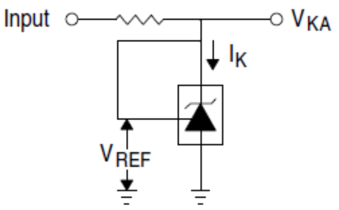
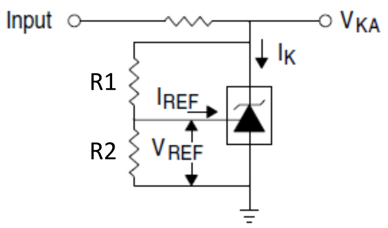


FIGURE 2

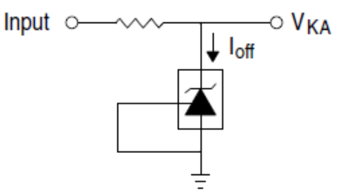
TEST CIRCUIT FOR $V_{KA} > V_{REF}$



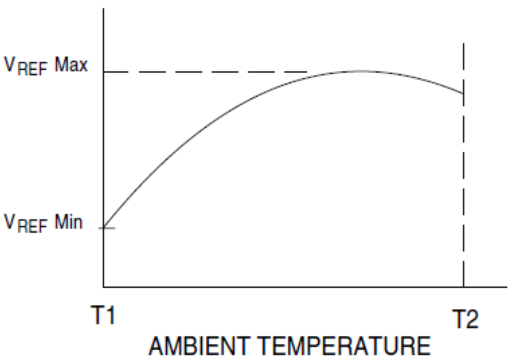
$$V_{KA} = V_{REF}\left(1 + \frac{R1}{R2}\right) + I_{REF} \times R1$$

FIGURE 3

TEST CIRCUIT FOR I_{off}



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, $\Delta T_A = 70°C$

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

The dynamic impedance Z_{ka} is defined as:

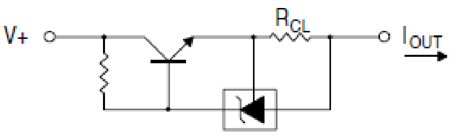
$$|Z_{ka}| = \frac{\Delta V_{KA}}{\Delta I_K}$$

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:

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

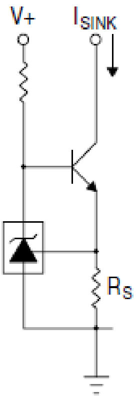
Typical Applications

CONSTANT CURRENT SOURCE



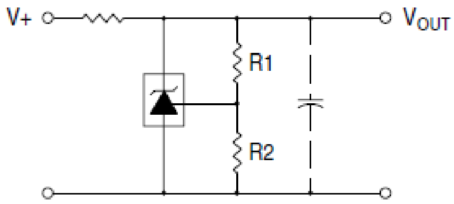
$$I_{OUT} = \frac{V_{REF}}{R_{CL}}$$

CONSTANT CURRENT SINK



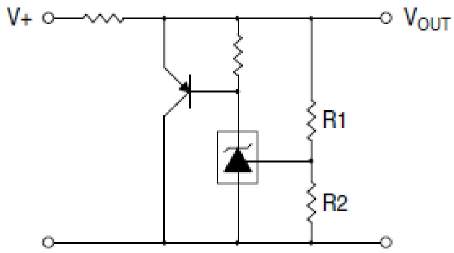
$$I_{SINK} = \frac{V_{REF}}{R_S}$$

SHUNT REGULATOR



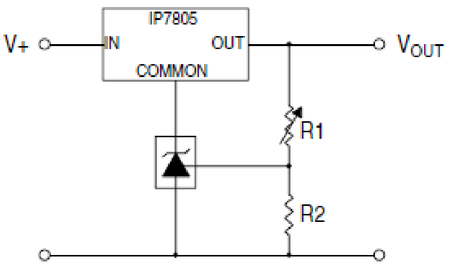
$$V_{OUT} = 1+\left(\frac{R1}{R2}\right)V_{REF}$$

HIGH CURRENT SHUNT REGULATOR



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

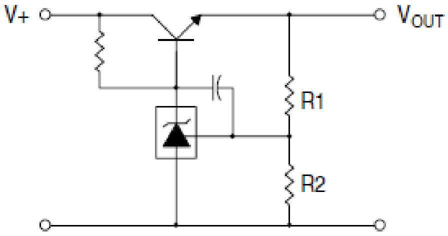
OUTPUT CONTROL OF A THREE-TERMINAL FIXED REGULATOR



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

$$V_{OUT(min)} = V_{REF} + 5V$$

SERIES PASS REGULATOR



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

$$V_{OUT(min)} = V_{REF} + V_{BE}$$

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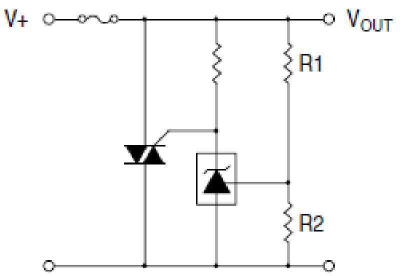
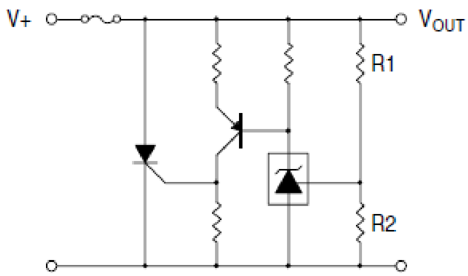
Typical Applications (Continued)

TRIAC CROWBAR



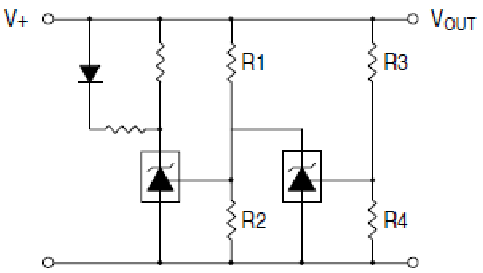
$$V_{OUT(trip)} = 1+\left(\frac{R1}{R2}\right)V_{REF}$$

THYRISTOR CROWBAR



$$V_{OUT(trip)} = 1+\left(\frac{R1}{R2}\right)V_{REF}$$

VOLTAGE MONITOR

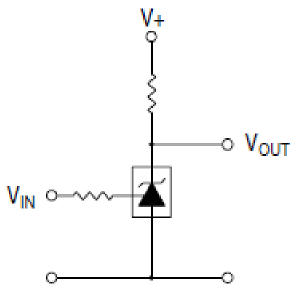


LED is 'on' when V+ is between the upper and lower limits.

$$\text{Lower Limit} = \left(1+\frac{R1}{R2}\right)V_{REF}$$

$$\text{Upper Limit} = \left(1+\frac{R3}{R4}\right)V_{REF}$$

SINGLE SUPPLY COMPARATOR WITH TEMPERATURE COMPENSATED THRESHOLD



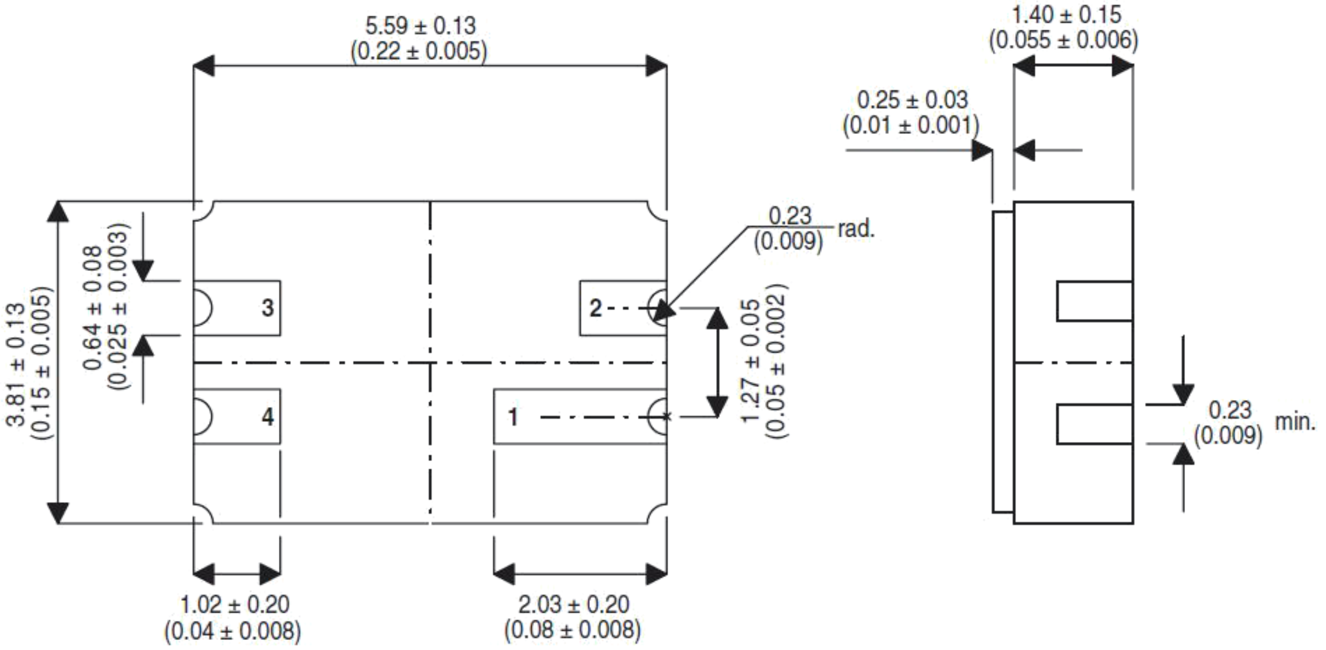
$V_{TH} = V_{REF}$

V_{IN}	V_{OUT}
$< V_{REF}$	V+
$> V_{REF}$	≈ 2.0 V

Packaging

Mechanical Data

Dimensions in mm (Inches)



LCC3 PACKAGE (MO-041BA)

Underside View

PAD 1 - Not Connected
PAD 2 - Cathode
PAD 3 - Reference
PAD 4 - Anode

Part Number Variants

PART NUMBER SUFFIX	TERMINAL FINISH (3)	SML ROHS
SILVR431371C3**A**	Standard Finish – Gold	G4(4)

Notes:

(3) Specify terminal finish option by part number at point of order. Other terminal finishes available upon request, please contact TT Electronics customer services.

(4) G4 = e4, as defined in J-STD-609 2nd Level Interconnect Category.

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