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NTE999SM
Integrared Circuit
Programmable Precision Reference

Description:

The NTE999SM integrated circuit is a three–terminal programmable shunt regulator. This monolithic IC voltage reference operates as a low temperature coefficient zener which is programmable from V_{ref} to 36 volts with two external resistors. This device exhibits a wide operating current range of 1.0 to 100mA with a typical dynamic impedance of 0.22Ω. The characteristics of this reference make it an excellent replacement for zener diodes in many applications such as digital voltmeters, power supplies, and op amp circuitry. The 2.5 volt reference makes it convenient to obtain a stable reference from 5.0 volt logic supplies, and since the NTE999SM operates as a shunt regulator, it can be used as either a positive or negative voltage reference.

Features:

- Programmable Output Voltage to 36 Volts
- Voltage Reference Tolerance: ±1.0%
- Low Dynamic Output Impedance: 0.22Ω Typical
- Sink Current Capability of 1.0 to 100mA
- Equivalent Full Range Temperature Coefficient of 50ppm/°C Typical
- Temperature Compensated for Operation over Full Rated Operating Temperature Range
- Low Output Noise Voltage.

Absolute Maximum Ratings: (T_A = 0° to +70°C, unless otherwise noted.)

Cathode to Anode Voltage, V_{KA} 37V
Cathode Current Range, Continuous, I_K . . . . –100 to +150mA
Reference Input Current Range, Continuous, I_{ref} . . . . –0.05 to +10mA
Total Power Dissipation (T_A = +25°C), P_D 725mW
Derate Above 25°C . . . . 5.8mW/°C
Operating Junction Temperature, T_J . . . . +150°C
Operating Ambient Temperature Range, T_A . . . . 0° to +70°C
Storage Temperature Range, T_{stg} . . . . –65° to +150°C
Thermal Resistance, Junction–to–Ambient, R_{thJA} . . . . 178°C/W
Thermal Resistance, Junction–to–Case, R_{thJC} . . . . 83°C/W
Lead Temperature (During Soldering, 1/16” ifrom case for 10sec), T_L . . . . +260°C

Recommended Operating Conditions	**Min**	**Max**	**Unit**
Cathode to Anode Voltage, V_{KA}	V_{ref}	36	V
Cathode Current, I_K	1.0	100	mA

Electrical Characteristics (T_A = +25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Reference Input Voltage $V_{KA} = V_{ref}$, I_K = 10mA T_A = +25°C	V_{ref}	2.470	2.495	2.520	V
Reference Input Voltage Deviation Over Temperature Range (Note 1, 2) $V_{KA} = V_{ref}$, I_K = 10mA	ΔV_{ref}	–	3.0	17	mV
Ratio of Change in Reference Input Voltage to Change in Cathode to Anode Voltage I_K = 10mA, ΔV_{KA} = 10V to V_{ref} ΔV_{KA} = 36V to 10V	$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	– –	–1.4 –1.0	–2.7 –2.0	mV/V
Reference Input Current I_K = 10mA, R1 = 10k, R2 = ∞ T_A = +25°C $T_A = T_{low}$ to T_{high} (Note 1)	I_{ref}	– –	1.8 –	4.0 5.2	μA
Reference Input Current Deviation Over Temperature Range (Note 1) I_K = 10mA, R1 = 10k, R2 = ∞	ΔI_{ref}	–	1.8	4.0	μA
Minimum Cathode Current for Regulation $V_{KA} = V_{ref}$	I_{min}	–	0.5	1.0	mA
Off–State Cathode Current V_{KA} = 36V, V_{ref} = 0V	I_{off}	–	2.6	1000	nA
Dynamic Impedance (Note 3) $V_{KA} = V_{ref}$, ΔI_K = 1.0mA to 100mA f ≤ 1.0kHz	$\lvert Z_{ka} \rvert$	–	0.22	0.5	Ω

Note 1: T_{low} = 0°C, T_{high} = +70°C

Note 2: 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.

$\Delta V_{ref} = V_{ref}Max - V_{ref}Min$
$\Delta T_A = T_2 - T_1$

Note 2: (cont'd) The average temperature coefficient of the reference input voltage, $\alpha\, V_{ref}$, is defined as:

$$\alpha\, V_{ref}\ \frac{ppm}{^\circ C} = \frac{\left(\frac{\Delta V_{ref}}{V_{ref}\ @\ 25^\circ C}\right) \times 10^6}{\Delta T_A} = \frac{\Delta V_{ref} \times 10^6}{\Delta T_A\ (V_{ref}\ @\ 25^\circ C)}$$

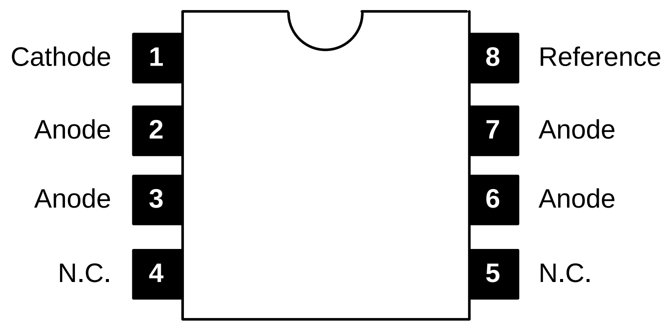
$\alpha\, V_{ref}$ can be positive or negative depending on whether V_{ref} Min or V_{ref} Max occurs at the lower ambient temperature.

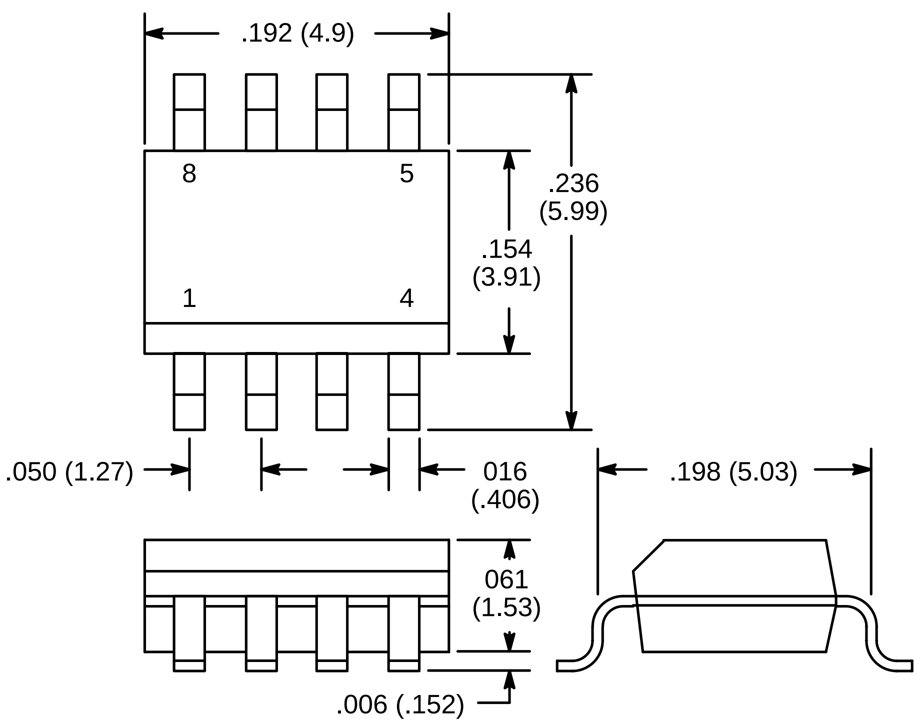
Note 3: The dynamic impedance Z_{ka} is defined as: $|Z_{ka}| = \dfrac{\Delta V_{KA}}{\Delta I_K}$

When the device is programmed with two external resistors, R1 and R2, the total dynamic impedance of the circuit is defined as:

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

Pin Connection Diagram





NOTE: Pin1 on Beveled Edge