

# AP4310AMTR-G1-HX IC for Output Regulation in Switching Chargers & Supplies

## Description

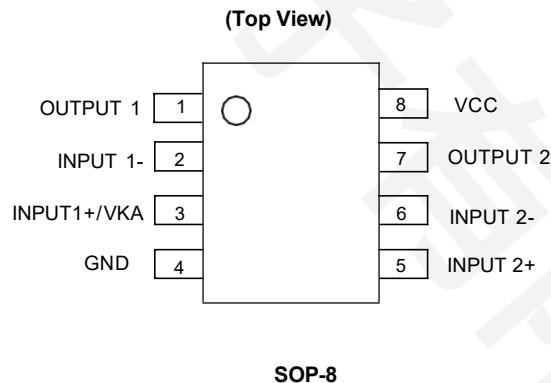
The AP4310AMTR-G1-HX is a monolithic IC tailored for regulating output current and voltage in switching battery chargers and power supplies. It incorporates two operational amplifiers (Op Amps) and a precise 2.5V shunt voltage reference. Op Amp 1, dedicated to voltage control, has its non-inverting input internally linked to the shunt regulator's output. Meanwhile, Op Amp 2, intended for current control, features uncommitted inputs for design flexibility.

This IC provides power converter designers with a solution that boasts enhanced precision while simultaneously simplifying the system and reducing costs. Additionally, the AP4310AMTR-G1-HX offers stricter reference voltage tolerance and offset specifications. It comes in a standard SOP-8 package.

## Applications

- ★ Battery Charger
- ★ Switching Power Supply

## Pin Assignments



## Features

### OP Amp

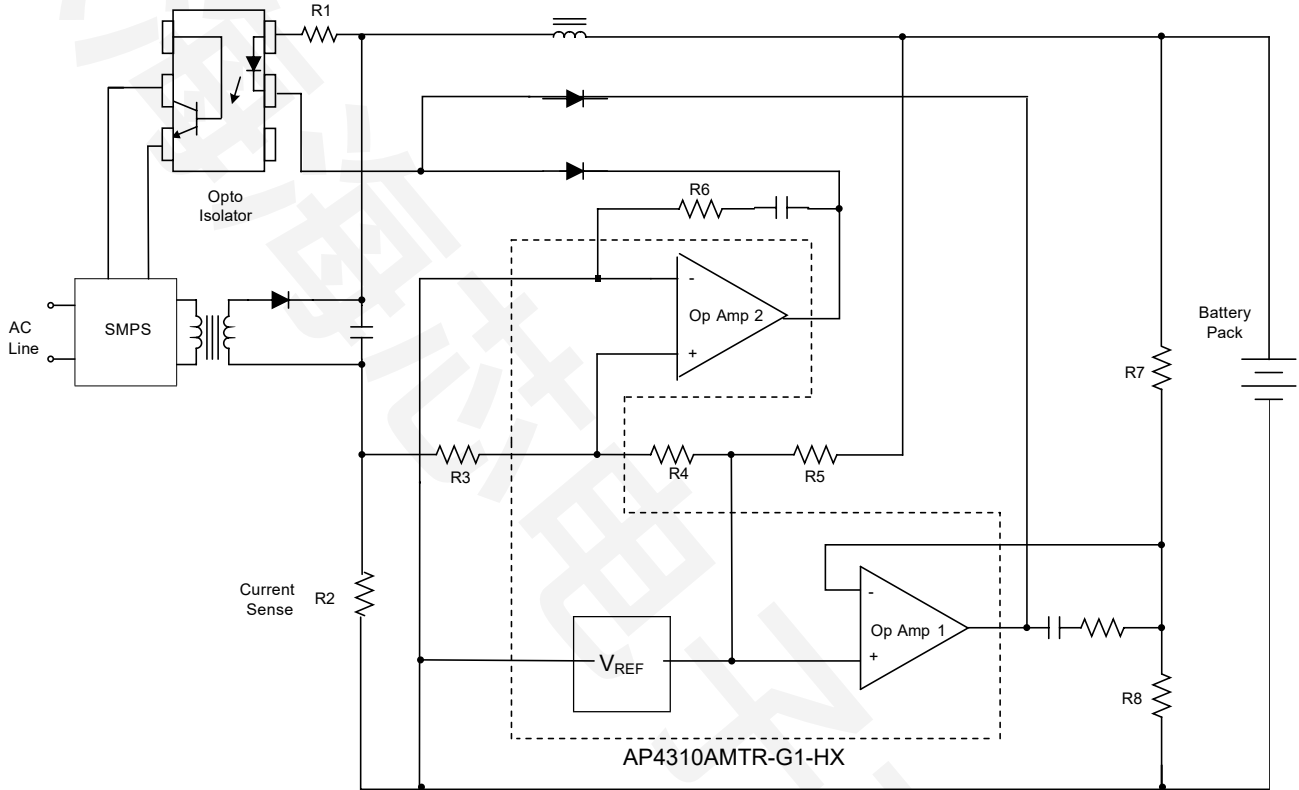
- ★ Input Offset Voltage: 0.5mV
- ★ Supply Current: 75 $\mu$ A per OP Amp at 5.0V Supply Voltage
- ★ Unity Gain Bandwidth: 1MHz
- ★ Output Voltage Swing: 0 to  $V_{CC}-1.5V$
- ★ Power Supply Range: 3 to 36V

## Voltage Reference

- ★ Fixed Output Voltage Reference: 2.5V
- ★ Reference Voltage Tolerance:  $\pm 0.4\%$
- ★ Sink Current Capability: 0.05 to 80mA
- ★ Typical Output Impedance: 0.2 $\Omega$
- ★ Totally Lead-free & Fully RoHS Compliant (Notes 1 & 2)
- ★ Halogen and Antimony Free. "Green" Device (Note 3)

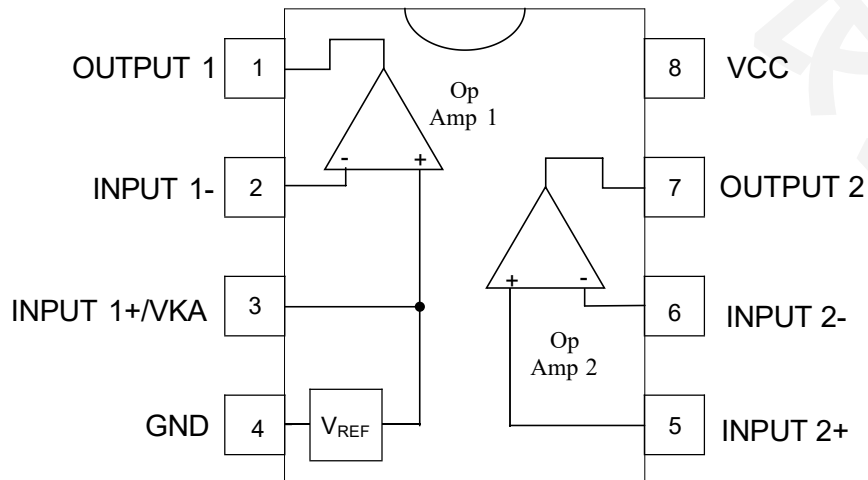
Notes: 1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.  
2. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

## Typical Applications Circuit



Application of AP4310AMTR-G1-HX in a Constant Current and Constant Voltage Charger

## Functional Block Diagram



## Absolute Maximum Ratings (Note 4)

Symbol	Parameter	Rating	Unit
V <sub>CC</sub>	Power Supply Voltage (V <sub>CC</sub> to GND)	40	V
V <sub>IN</sub>	Op Amp1 and 2 Input Voltage Range (Pins 2, 5, 6)	-0.3 to V <sub>CC</sub> +0.3	V
V <sub>ID</sub>	Op Amp 2 Input Differential Voltage (Pins 5, 6)	40	V
I <sub>K</sub>	Voltage Reference Cathode Current (Pin 3)	100	mA
P <sub>D</sub>	Power Dissipation (T <sub>A</sub> =+25°C)	500	mW
T <sub>J</sub>	Operating Junction Temperature	+150	°C
T <sub>STG</sub>	Storage Temperature Range	-65 to +150	°C
T <sub>LEAD</sub>	Lead Temperature (Soldering 10sec)	+260	°C

Note 4: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

## Recommended Operating Conditions (Note 5)

Parameter	Min	Max	Unit
Supply Voltage	3	36	V
Ambient Temperature	-40	+105	°C

Note 5: Qualified for SMD on the underside of a PCB by processing the PCB through a wave soldering operation.

Electrical Characteristics (@V<sub>CC</sub>=5V, T<sub>A</sub>=+25°C, unless otherwise specified.)

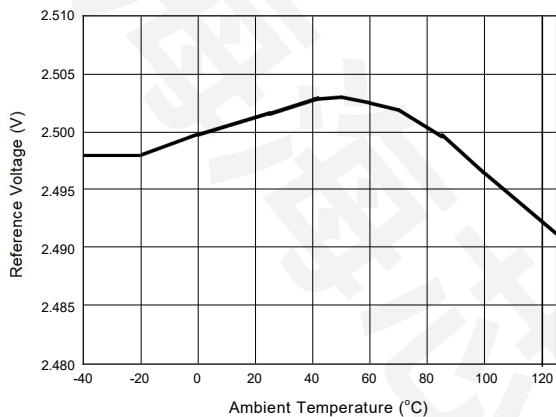
Parameters	Conditions	Min	Typ	Max	Unit	
Total Supply Current, excluding Current in Voltage Reference	V <sub>CC</sub> =5V, no load, -40°C≤T <sub>A</sub> ≤+105°C	-	0.15	0.25	mA	
	V <sub>CC</sub> =30V, no load, -40°C≤T <sub>A</sub> ≤+105°C	-	0.20	0.30		
<b>Voltage Reference Section</b>						
Reference Voltage	I <sub>K</sub> =10mA	T <sub>A</sub> =+25°C	2.49	2.50	2.51	V
		-40°C≤T <sub>A</sub> ≤+105°C	2.48	2.50	2.52	
Reference Voltage Deviation over Full Temperature Range	I <sub>K</sub> =10mA, T <sub>A</sub> =-40°C to +105°C	-	5	24	mV	
Minimum Cathode Current for Regulation	-	-	0.01	0.05	mA	
Dynamic Impedance	I <sub>K</sub> =1mA to 80mA, f<1kHz	-	0.2	0.5	Ω	
<b>Op Amp 1 Section (V<sub>CC</sub>=5V, V<sub>O</sub>=1.4V, T<sub>A</sub>=+25°C, unless otherwise noted.)</b>						
Input Offset Voltage	T <sub>A</sub> =+25°C	-	0.5	3	mV	
	T <sub>A</sub> =-40°C to +105°C	-	-	5		
Input Offset Voltage Temperature Drift	T <sub>A</sub> =-40°C to +105°C	-	7	-	μV/°C	
Input Bias Current (Inverting Input Only)	T <sub>A</sub> =+25°C	-	20	150	nA	
Large Signal Voltage Gain	V <sub>CC</sub> =15V, R <sub>L</sub> =2kΩ, V <sub>O</sub> =1.4V to 11.4V	85	100	-	dB	
Power Supply Rejection Ratio	V <sub>CC</sub> =5V to 30V	70	90	-	dB	

**Electrical Characteristics** (Cont.) (@V<sub>CC</sub>=5V, T<sub>A</sub>=+25°C, unless otherwise specified.)

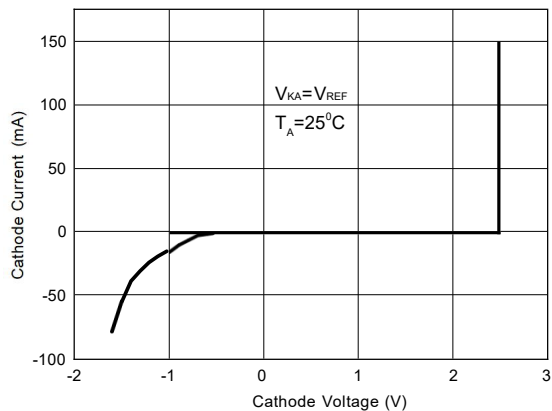
Parameters		Conditions	Min	Typ	Max	Unit
Output Current	Source	V <sub>CC</sub> = 15V, V <sub>ID</sub> =1V, V <sub>O</sub> = 2V	20	40	-	mA
	Sink	V <sub>CC</sub> = 15V, V <sub>ID</sub> = -1V, V <sub>O</sub> = 2V	8	20	-	
Output Voltage Swing (High)		V <sub>CC</sub> = 30V, R <sub>L</sub> = 10kΩ, V <sub>ID</sub> = 1V	27	28	-	V
Output Voltage Swing (Low)		V <sub>CC</sub> = 30V, R <sub>L</sub> = 10kΩ, V <sub>ID</sub> = -1V	-	17	100	mV
Slew Rate		V <sub>CC</sub> = 18V, R <sub>L</sub> = 2kΩ, A <sub>v</sub> = 1, V <sub>IN</sub> = 0.5V to 2V, C <sub>L</sub> = 100pF	0.2	0.5	-	V/μs
Unity Gain Bandwidth		V <sub>CC</sub> = 30V, R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF	0.7	1.0	-	MHz
<b>Op Amp 2 Section</b> (V <sub>CC</sub> = 5V, V <sub>O</sub> =1.4V, T <sub>A</sub> =+25°C, unless otherwise noted.)						
Input Offset Voltage (Note 6)		T <sub>A</sub> = +25°C, V <sub>CC</sub> = 5V or 20V	-	0.5	2	mV
		T <sub>A</sub> = -40°C to +105°C, V <sub>CC</sub> = 5V or 20V	-	-	3	
Input Offset Voltage Temperature Drift		T <sub>A</sub> = -40°C to +105°C	-	7	-	μV/°C
Input Offset Current		T <sub>A</sub> = +25°C	-	2	30	nA
Input Bias Current		T <sub>A</sub> = +25°C	-	20	150	nA
Input Voltage Range		V <sub>CC</sub> = 0 to 36V	0	-	V <sub>CC</sub> -1.5	V
Common Mode Rejection Ratio		T <sub>A</sub> = +25°C, V <sub>CM</sub> = 0 to 3.5V	70	85	-	dB
Large Signal Voltage Gain		V <sub>CC</sub> = 15V, R <sub>L</sub> = 2kΩ, V <sub>O</sub> = 1.4V to 11.4V	85	100	-	dB
Power Supply Rejection Ratio		V <sub>CC</sub> = 5V to 30V	70	90	-	dB
Output Current	Source	V <sub>CC</sub> = 15V, V <sub>ID</sub> = 1V, V <sub>O</sub> = 2V	20	40	-	mA
	Sink	V <sub>CC</sub> = 15V, V <sub>ID</sub> = -1V, V <sub>O</sub> = 2V	8	20	-	
Output Voltage Swing (High)		V <sub>CC</sub> = 30V, R <sub>L</sub> = 10kΩ, V <sub>ID</sub> = 1V	27	28	-	V
Output Voltage Swing (Low)		V <sub>CC</sub> = 30V, R <sub>L</sub> = 10kΩ, V <sub>ID</sub> = -1V	-	17	100	mV
Slew Rate		V <sub>CC</sub> = 18V, R <sub>L</sub> = 2kΩ, A <sub>v</sub> = 1, V <sub>IN</sub> = 0.5V to 2V, C <sub>L</sub> = 100pF	0.2	0.5	-	V/μs
Unity Gain Bandwidth		V <sub>CC</sub> = 30V, R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF	0.7	1.0	-	MHz

Note 6: The full temperature feature is guaranteed by design.

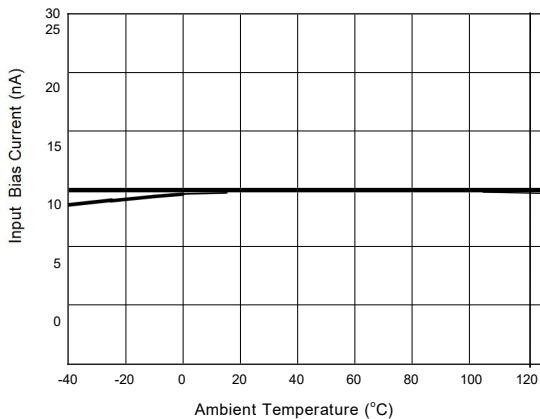
## Performance Characteristics



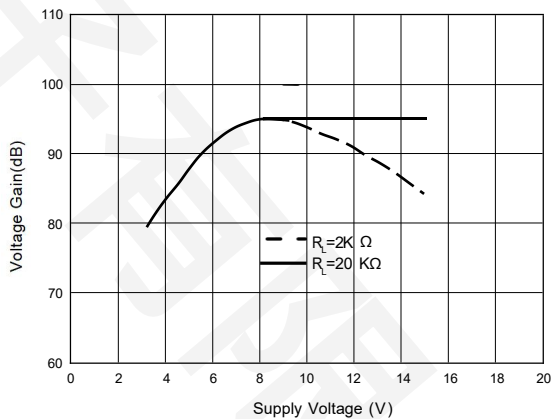
Reference Voltage vs. Ambient Temperature



Cathode Current vs. Cathode Voltage



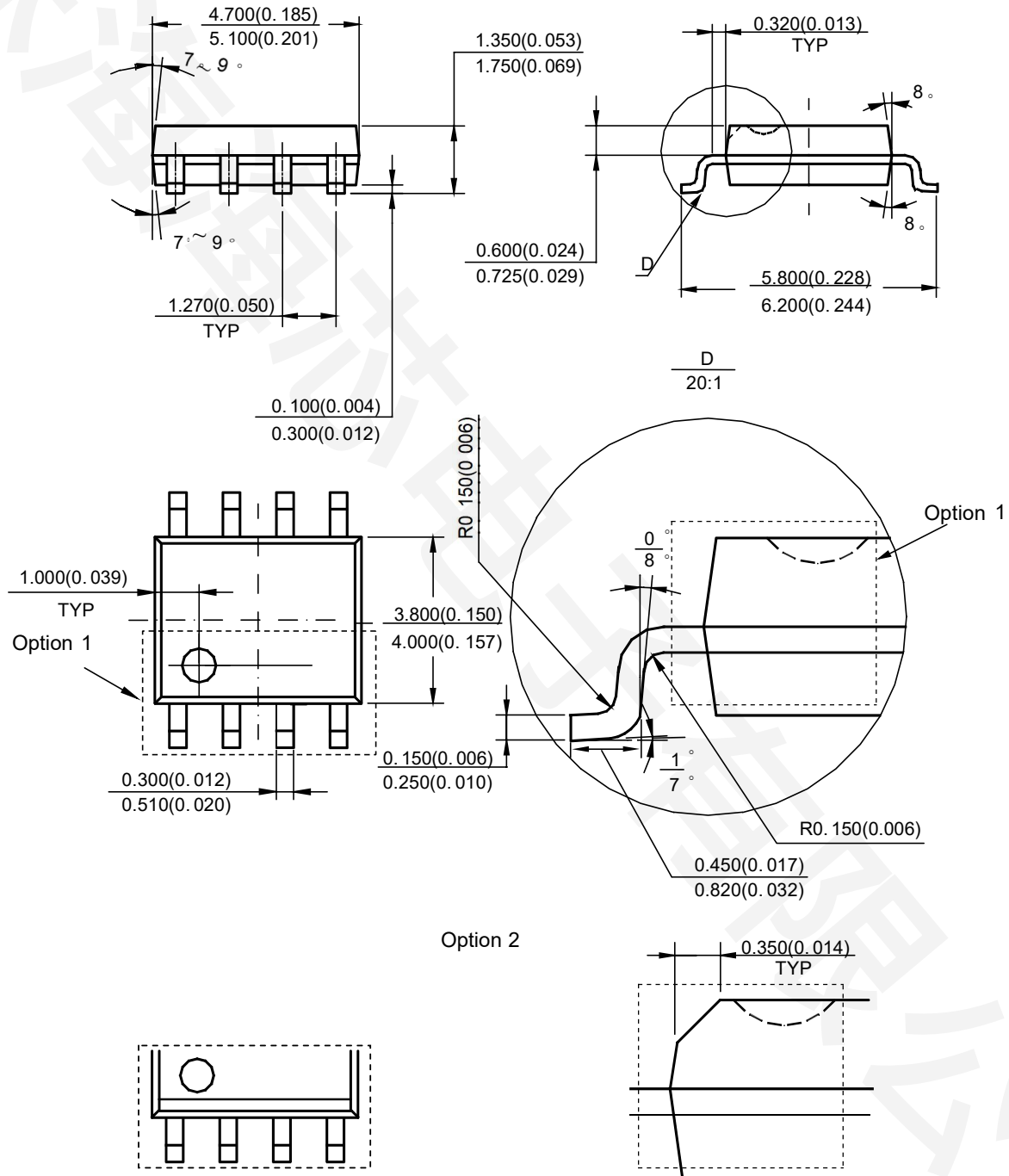
Input Bias Current vs. Ambient Temperature



Op Amp Voltage Gain

## Package Outline Dimensions (All dimensions in mm (inch).)

### SOP-8

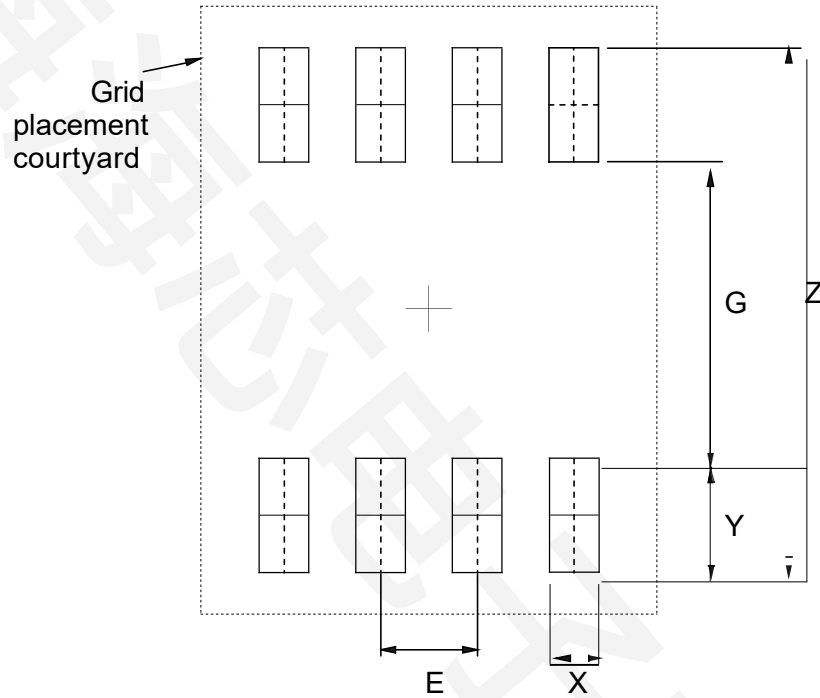


Note: Eject hole , oriented hole and mold mark is optional .

Temperature Range	Reference Voltage	Voltage Tolerance	Packing
-40 to +105°C	2.5V	±0.4%	4000/Tape

## Suggested Pad Layout

### SOP-8



Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E (mm)/(inch)
Value	6.900/0.272	3.900/0.154	0.650/0.026	1.500/0.059	1.270/0.050