

DUAL OP AMP AND VOLTAGE REFERENCE
Description

The AP4310A is a monolithic IC specifically designed to regulate the output current and voltage levels of switching battery chargers and power supplies.

The device contains two Op Amps and a 2.5V precision shunt voltage reference. Op Amp 1 is designed for voltage control with its non-inverting input internally connected to the output of the shunt regulator. Op Amp 2 is for current control with both inputs uncommitted. The IC offers the power converter designer a control solution that features increased precision with a corresponding reduction in system complexity and cost.

The AP4310A is available in SO-8 package.

Features
OP Amp

- Input Offset Voltage: 0.5mV
- Supply Current: 75μA 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

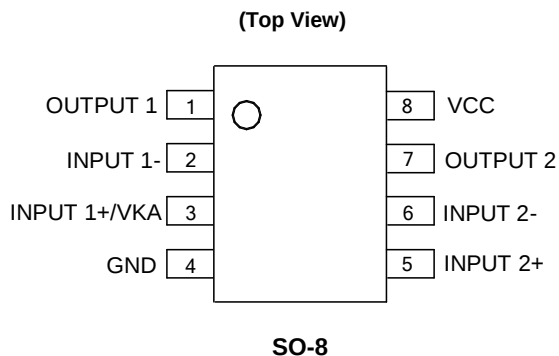
Voltage Reference

- Fixed Output Voltage Reference: 2.5V
- Reference Voltage Tolerance: $\pm 0.4\%$
- Sink Current Capability: 0.05 to 80mA
- Typical Output Impedance: 0.2Ω

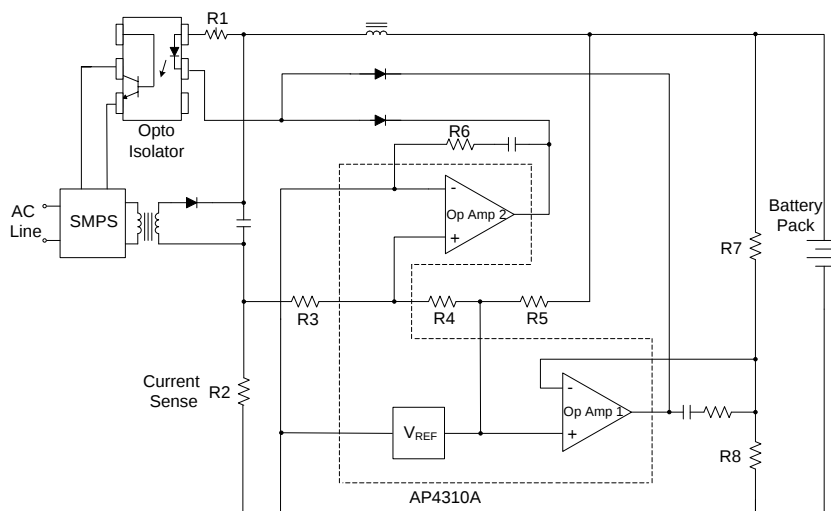
- **Totally Lead-free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See http://www.diodes.com/quality/lead_free.html for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

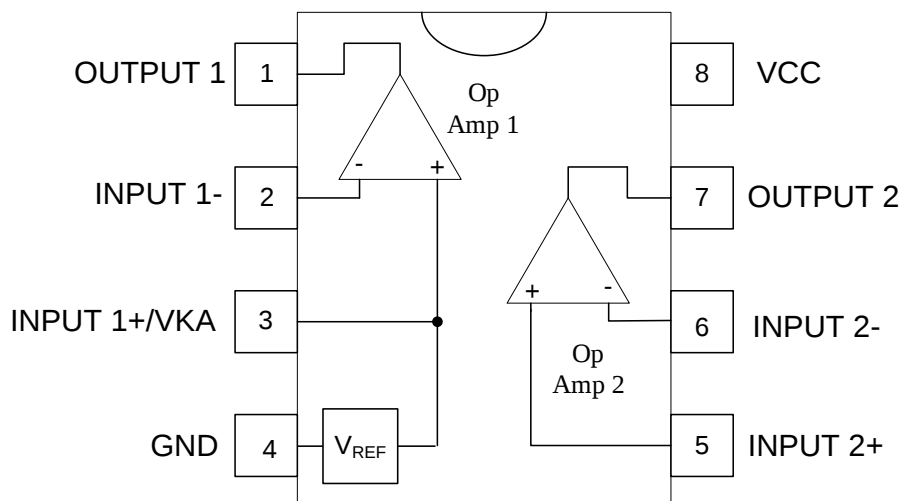
Pin Assignments

Applications

- Battery Charger
- Switching Power Supply

Typical Applications Circuit


Application of AP4310A in a Constant Current and Constant Voltage Charger

Functional Block Diagram



Absolute Maximum Ratings (Note 4)

Symbol	Parameter	Rating	Unit
V_{CC}	Power Supply Voltage (VCC to GND)	40	V
V_{IN}	Op Amp1 and 2 Input Voltage Range (Pins 2, 5, 6)	-0.3 to $V_{CC}+0.3$	V
V_{ID}	Op Amp 2 Input Differential Voltage (Pins 5, 6)	40	V
I_K	Voltage Reference Cathode Current (Pin 3)	100	mA
P_D	Power Dissipation ($T_A = +25^{\circ}C$)	500	mW
T_J	Operating Junction Temperature	+150	$^{\circ}C$
T_{STG}	Storage Temperature Range	-65 to +150	$^{\circ}C$
T_{LEAD}	Lead Temperature (Soldering 10sec)	+260	$^{\circ}C$
ESD	ESD (Human Body Model)	≥ 2000	V

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

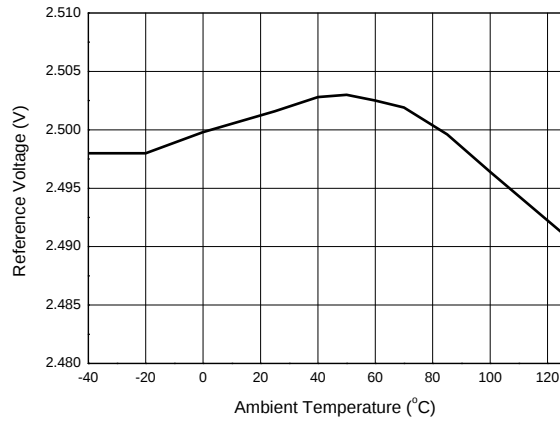
Parameter	Min	Max	Unit
Supply Voltage	3	36	V
Ambient Temperature	-40	+105	$^{\circ}C$

Electrical Characteristics (@V_{CC}=5V, T_A=+25°C, unless otherwise specified.)

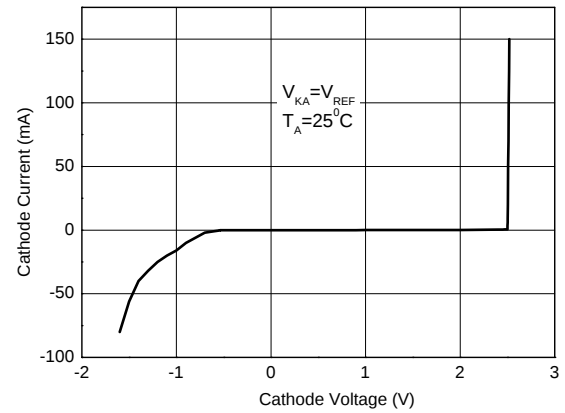
Parameters		Conditions	Min	Typ	Max	Unit	
Total Supply Current, excluding Current in Voltage Reference		V _{CC} =5V, no load, -40°C ≤ T _A ≤ +105°C	–	0.15	0.25	mA	
		V _{CC} =30V, no load, -40°C ≤ T _A ≤ +105°C	–	0.20	0.30		
Voltage Reference Section							
Reference Voltage		I _K =10mA	T _A = +25°C	2.49	2.50	2.51	V
			-40°C ≤ T _A ≤ +105°C	2.48	2.50	2.52	
Reference Voltage Deviation over Full Temperature Range		I _K =10mA, T _A = -40°C to +105°C		–	5	24	mV
Minimum Cathode Current for Regulation		–		–	0.01	0.05	mA
Dynamic Impedance		I _K =1mA to 80mA, f<1kHz		–	0.2	0.5	Ω
Op Amp 1 Section (V _{CC} = 5V, V _O = 1.4V, T _A = +25°C, unless otherwise noted.)							
Input Offset Voltage		T _A = +25°C		–	0.5	3	mV
		T _A = -40°C to +105°C		–	–	5	
Input Offset Voltage Temperature Drift		T _A = -40°C to +105°C		–	7	–	μV/°C
Input Bias Current (Inverting Input Only)		T _A = +25°C		–	20	150	nA
Large Signal Voltage Gain		V _{CC} = 15V, R _L = 2kΩ, V _O = 1.4V to 11.4V		85	100	–	dB
Power Supply Rejection Ratio		V _{CC} = 5V to 30V		70	90	–	dB
Output Current	Source	V _{CC} = 15V, V _{ID} = 1V, V _O = 2V		20	40	–	mA
	Sink	V _{CC} = 15V, V _{ID} = -1V, V _O = 2V		5	20	–	
Output Voltage Swing (High)		V _{CC} = 30V, R _L = 10kΩ, V _{ID} = 1V		27	28	–	V
Output Voltage Swing (Low)		V _{CC} = 30V, R _L = 10kΩ, V _{ID} = -1V		–	17	100	mV
Slew Rate		V _{CC} = 18V, R _L = 2kΩ, A _V = 1, V _{IN} = 0.5V to 2V, C _L = 100pF		0.2	0.5	–	V/μs
Unity Gain Bandwidth		V _{CC} = 30V, R _L = 2kΩ, C _L = 100pF		0.7	1.0	–	MHz
Op Amp 2 Section (V _{CC} = 5V, V _O = 1.4V, T _A = +25°C, unless otherwise noted.)							
Input Offset Voltage		T _A = +25°C		–	0.5	3	mV
		T _A = -40°C to +105°C		–	–	5	
Input Offset Voltage Temperature Drift		T _A = -40°C to +105°C		–	7	–	μV/°C
Input Offset Current		T _A = +25°C		–	2	30	nA
Input Bias Current		T _A = +25°C		–	20	150	nA
Input Voltage Range		V _{CC} = 0 to 36V		0	–	V _{CC} -1.5	V
Common Mode Rejection Ratio		T _A = +25°C, V _{CM} = 0 to 3.5V		70	85	–	dB
Large Signal Voltage Gain		V _{CC} = 15V, R _L = 2kΩ, V _O = 1.4V to 11.4V		85	100	–	dB
Power Supply Rejection Ratio		V _{CC} = 5V to 30V		70	90	–	dB
Output Current	Source	V _{CC} = 15V, V _{ID} = 1V, V _O = 2V		20	40	–	mA
	Sink	V _{CC} = 15V, V _{ID} = -1V, V _O = 2V		5	20	–	
Output Voltage Swing (High)		V _{CC} = 30V, R _L = 10kΩ, V _{ID} = 1V		27	28	–	V
Output Voltage Swing (Low)		V _{CC} = 30V, R _L = 10kΩ, V _{ID} = -1V		–	17	100	mV
Slew Rate		V _{CC} = 18V, R _L = 2kΩ, A _V = 1, V _{IN} = 0.5V to 2V, C _L = 100pF		0.2	0.5	–	V/μs
Unity Gain Bandwidth		V _{CC} = 30V, R _L = 2kΩ, C _L = 100pF		0.7	1.0	–	MHz

Performance Characteristics

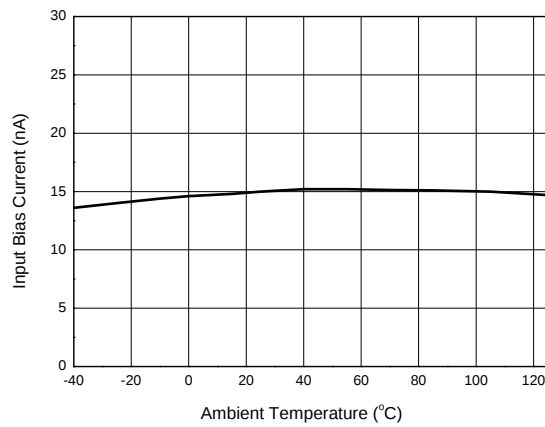
Reference Voltage vs. Ambient Temperature



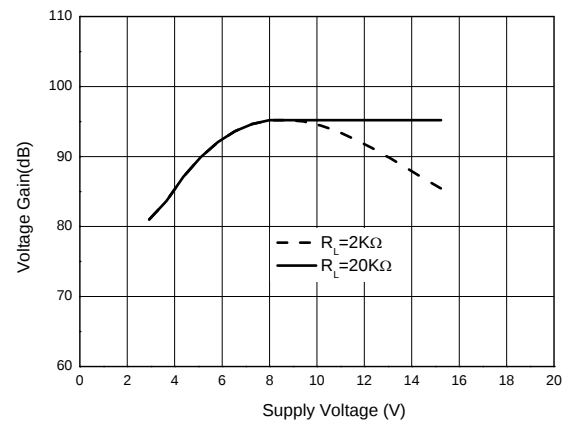
Cathode Current vs. Cathode Voltage



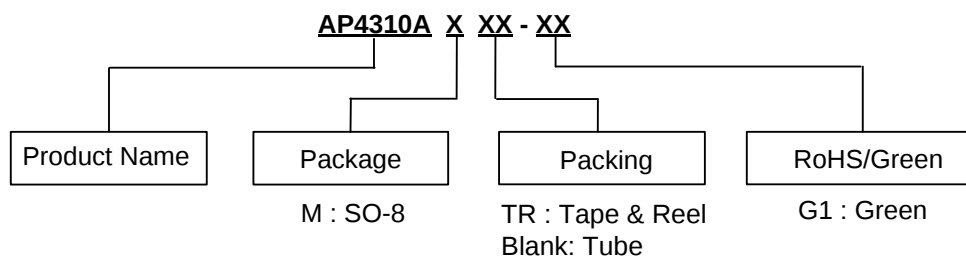
Input Bias Current vs. Ambient Temperature



Op Amp Voltage Gain



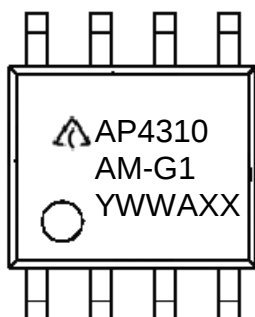
Ordering Information



Package	Temperature Range	Reference Voltage	Voltage Tolerance	Part Number	Marking ID	Packing
SO-8	-40 to +105°C	2.5V	±0.4%	AP4310AM-G1	AP4310AM-G1	100/Tube
				AP4310AMTR-G1	AP4310AM-G1	4000/Tape & Reel

Marking Information

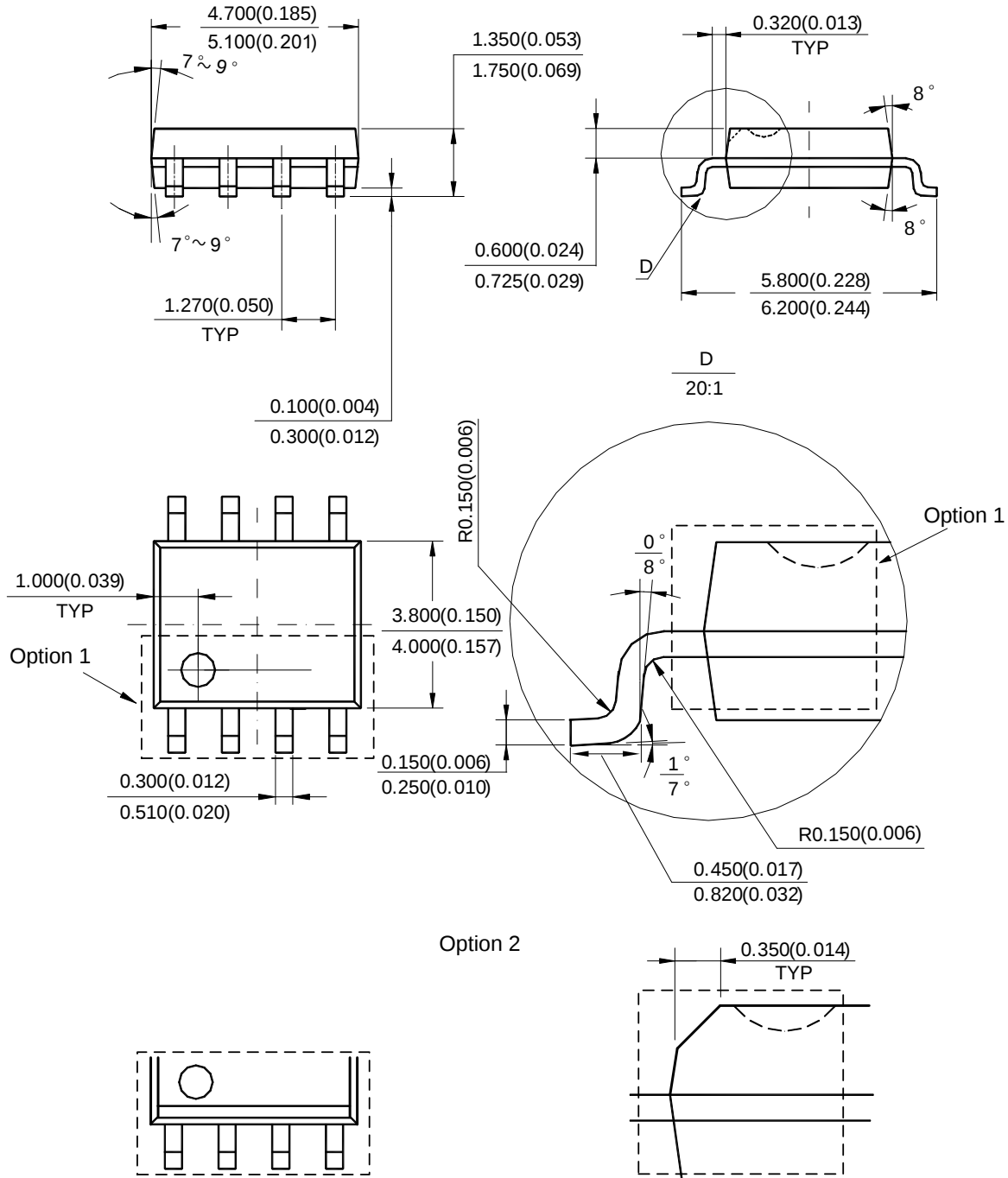
(Top View)



First and Second Lines: Logo and Marking ID
 Third Line: Date Code
 Y: Year
 WW: Work Week of Molding
 A: Assembly House Code
 XX: 7th and 8th Digits of Batch No.

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

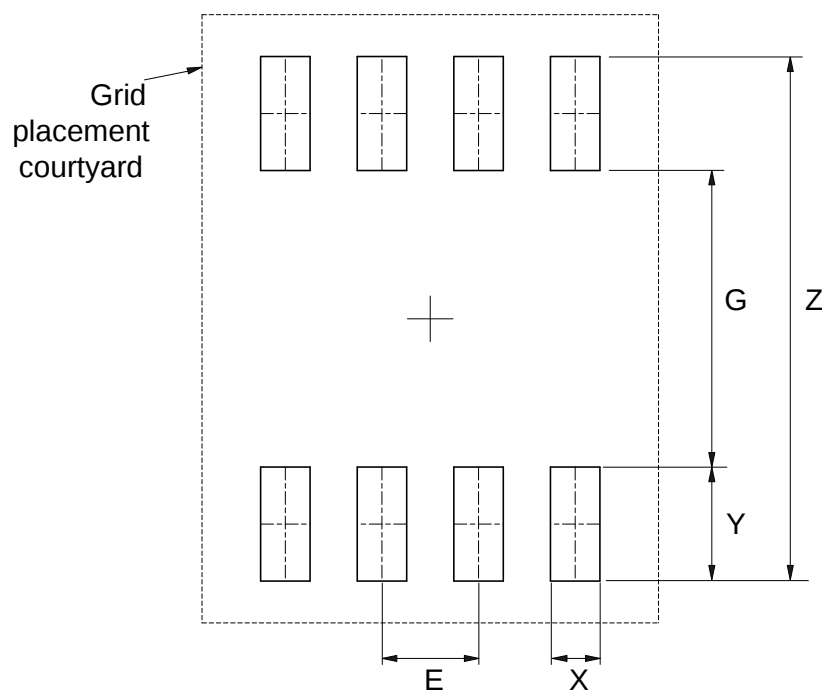
(1) Package Type: SO-8



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

Suggested Pad Layout

(1) Package Type: SO-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

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