DUAL OP AMP AND VOLTAGE REFERENCE AP4310

General Description

The AP4310 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 connects 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 AP4310 is available in standard packages of DIP-8 and SOIC-8.

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} - 1.5) V
- Power Supply Range: 3 to 36V

Voltage Reference

- Fixed Output Voltage Reference: 2.5V
- Voltage Tolerance: ± 0.4%, ± 1%
- Sink Current Capability: 0.05 to 80mA
- Typical Output Impedance: 0.2Ω

Applications

- Battery Charger
- Switching Power Supply

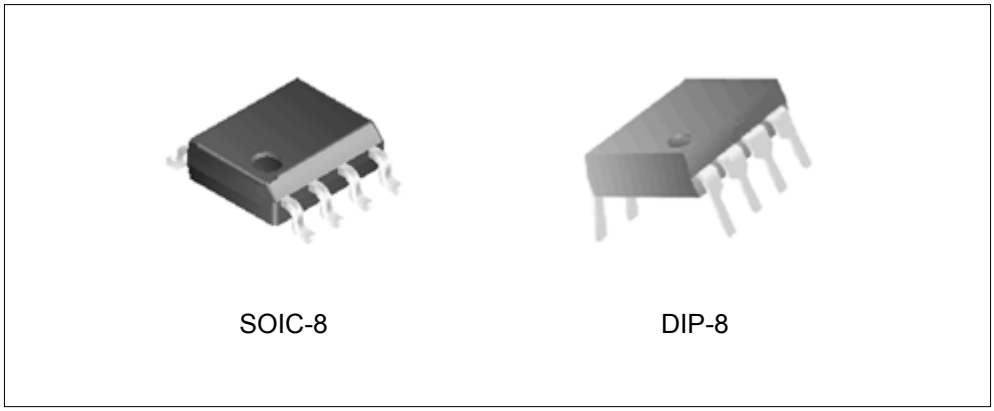


Figure 1. Package Types of AP4310

Pin Configuration

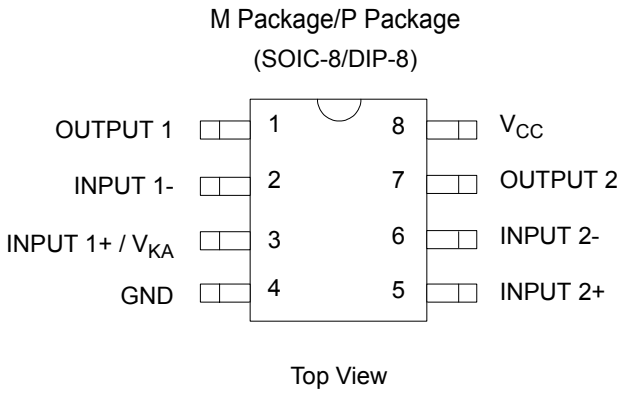


Figure 2. Pin Configuration of AP4310

Functional Block Diagram

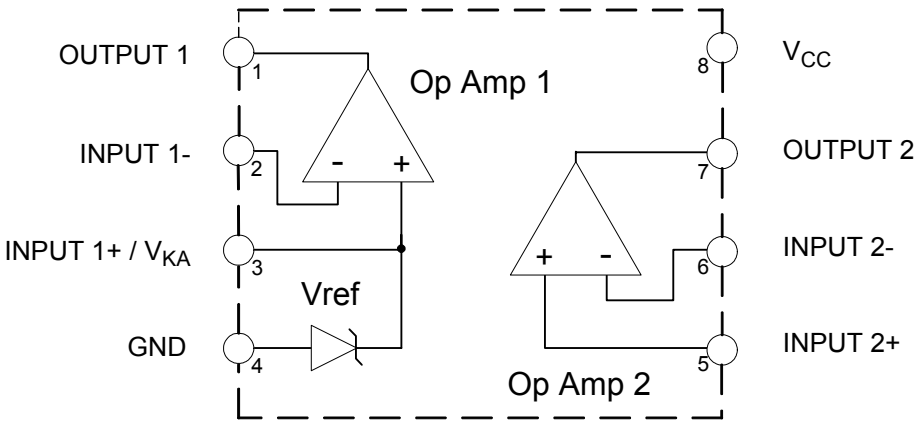
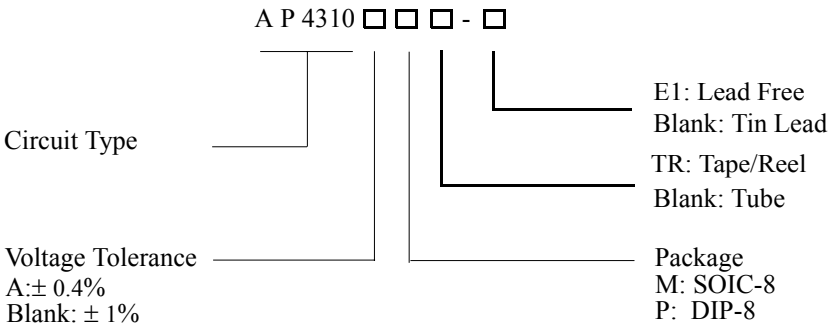


Figure 3. Functional Block Diagram of AP4310

Ordering Information



Package	Reference Voltage	Voltage Tolerance	Tempera-ture Range	Part Number		Marking ID		Packing Type
				Tin Lead	Lead Free	Tin Lead	Lead Free	
DIP-8	2.5V	± 0.4%	-40 to105°C	AP4310AP	AP4310AP-E1	AP4310AP	AP4310AP-E1	Tube
		± 1%		AP4310P	AP4310P-E1	AP4310P	AP4310P-E1	
SOIC-8	2.5V	± 0.4%	-40 to105°C	AP4310AM	AP4310AM-E1	4310AM	4310AM-E1	Tube
				AP4310AMTR	AP4310AMTR-E1	4310AM	4310AM-E1	Tape/Reel
		± 1%	-40 to105°C	AP4310M	AP4310M-E1	4310M	4310M-E1	Tube
				AP4310MTR	AP4310MTR-E1	4310M	4310M-E1	Tape/Reel

The listed part numbers are used during the transition to lead-free products. After the transition completed, lead-free products will be considered as the "standard" and we will resume the original part numbers.

Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value		Unit
Power Supply Voltage (V_{CC} to GND)	V_{CC}	40		V
Op Amp 1 and 2 Input Voltage Range (Pins 2, 5, 6)	V_{IN}	- 0.3 to V_{CC} + 0.3		V
Op Amp 2 Input Differential Voltage (Pins 5, 6)	V_{ID}	40		V
Voltage Reference Cathode Current (Pin 3)	I_K	100		mA
Power Dissipation	P_D	DIP-8	800	mW
		SOIC-8	500	
Storage Temperature Range	T_{STG}	-65 to 150		°C
ESD Protection Voltage (Human Body Model)		≥ 2000		V

Note 1: 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	°C

Electrical Characteristics

Operating Conditions: V_{CC} = +5V, T_A= 25°C unless otherwise specified.

Parameter		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	AP4310A	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	
	AP4310		T_A = 25°C	2.475	2.50	2.525	V
			-40°C ≤T_A ≤105°C	2.45	2.50	2.55	
Reference Voltage Deviation Over Full Temperature Range		I_K = 10mA, T_A = -40 to 105°C			5	24	mV
Minimum Cathode Current for Regulation					0.01	0.05	mA
Dynamic Impedance		I_K = 1.0 to 80mA, f<1kHz			0.2	0.5	Ω
Op Amp 1 Section (VCC = 5V, VO = 1.4V, TA = 25°C, unless otherwise noted)							
Input Offset Voltage		T_A = 25°C			0.5	3	mV
		T_A = -40 to 105°C				5	
Input Offset Voltage Temperature Drift		T_A = -40 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 = 1.4 to 11.4V		85	100		dB
Power Supply Rejection Ratio		V_{CC} = 5 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		7	20		mA
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} = 0.5 to 2V, C_L = 100pF		0.2	0.5		V/μ s
Unity Gain Bandwidth		V_{CC} = 30V, R_L = 2kΩ, C_L = 100pF		0.7	1.0		MHz

Electrical Characteristics (Continued)

Operating Conditions: V_{CC} = +5V, T_A= 25°C unless otherwise specified.

Parameter		Conditions	Min	Typ	Max	Unit
Op Amp 2 Section (VCC = 5V, VO = 1.4V, TA = 25oC, unless otherwise noted)						
Input Offset Voltage		T_A = 25°C		0.5	3	mV
		T_A = -40 to 105°C			5	
Input Offset Voltage Temperature Drift		T_A = -40 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 = 1.4 to 11.4V	85	100		dB
Power Supply Rejection Ratio		V_{CC} = 5 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	7	20		mA
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} = 0.5 to 2V, C_L = 100pF	0.2	0.5		V/μ s
Unity Gain Bandwidth		V_{CC} = 30V, R_L = 2kΩ, C_L = 100pF	0.7	1.0		MHz

Typical Performance Characteristics

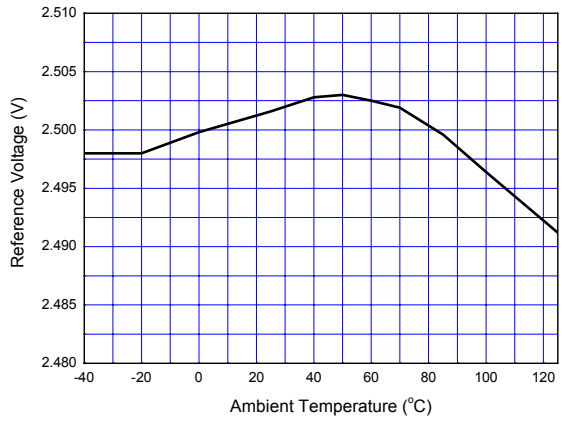


Figure 4. Reference Voltage vs. Ambient Temperature

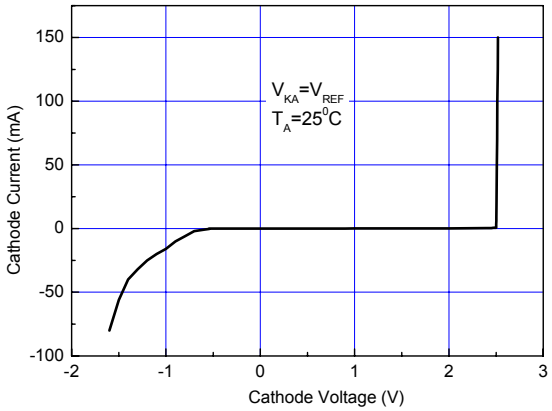


Figure 5. Cathode Current vs. Cathode Voltage

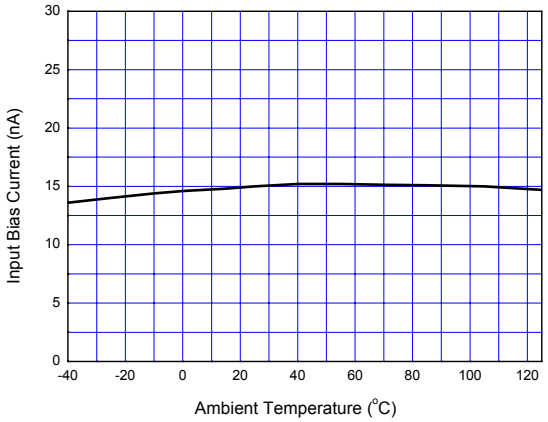


Figure 6. Input Bias Current vs. Ambient Temperature

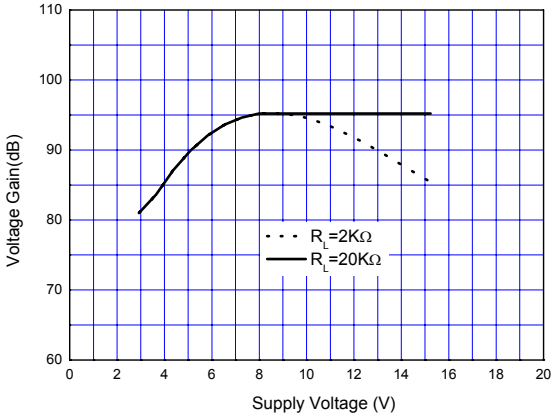


Figure 7. Op Amp Voltage Gain

Typical Application

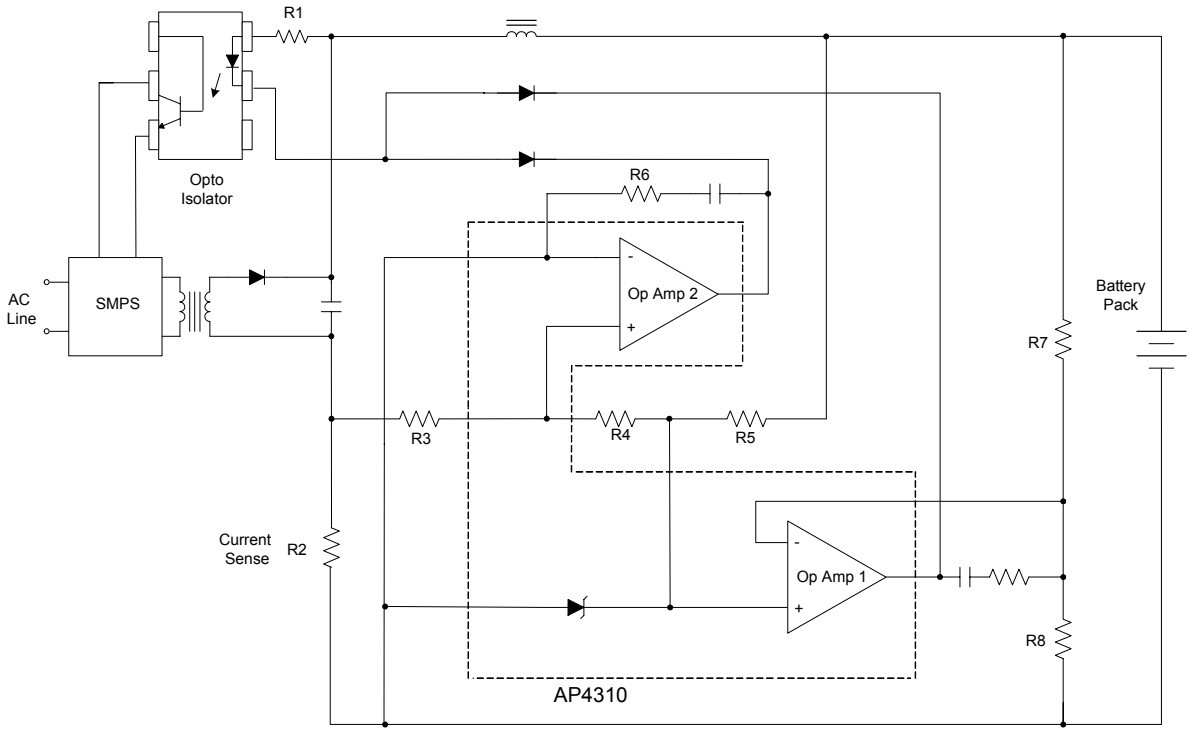


Figure 8. Application of AP4310 in a Constant Current and Constant Voltage Charger