

DUAL OP AMP AND VOLTAGE REFERENCE**AP4310/A****General Description**

The AP4310/A 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. AP4310A has more stringent reference voltage tolerance than AP4310.

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

Features**Op Amp**

- Input Offset Voltage: 0.5mV
- Supply Current: 75 μ A 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
- Reference Voltage Tolerance
AP4310A: $\pm 0.4\%$,
AP4310: $\pm 1\%$
- Sink Current Capability: 0.05 to 80mA
- Typical Output Impedance: 0.2 Ω

Applications

- Battery Charger
- Switching Power Supply

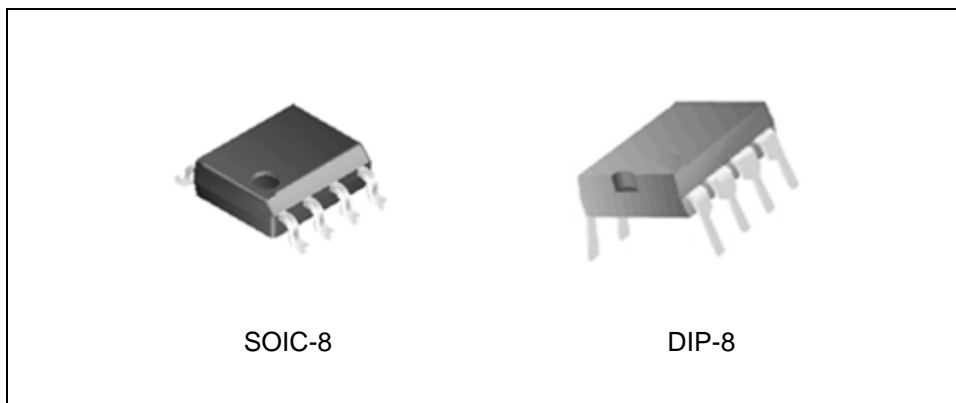


Figure 1. Package Types of AP4310/A

Pin Configuration

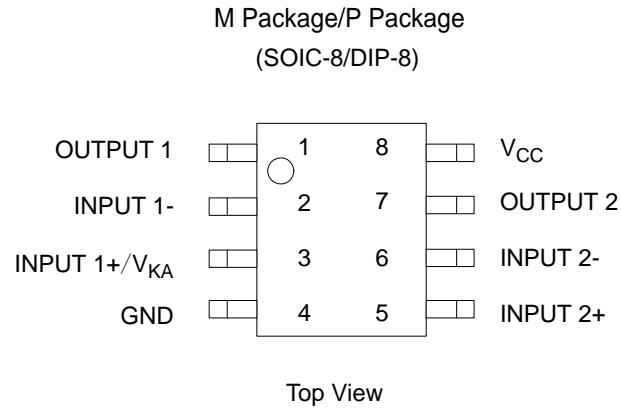


Figure 2. Pin Configuration of AP4310/A

Functional Block Diagram

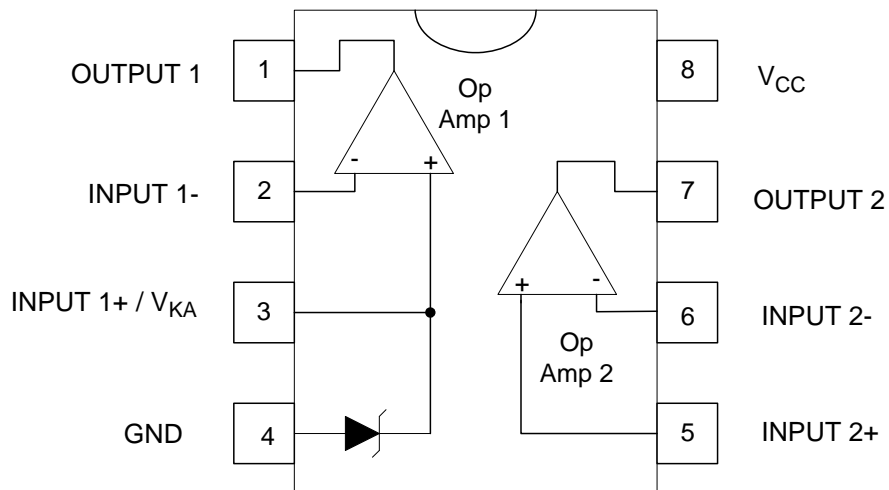


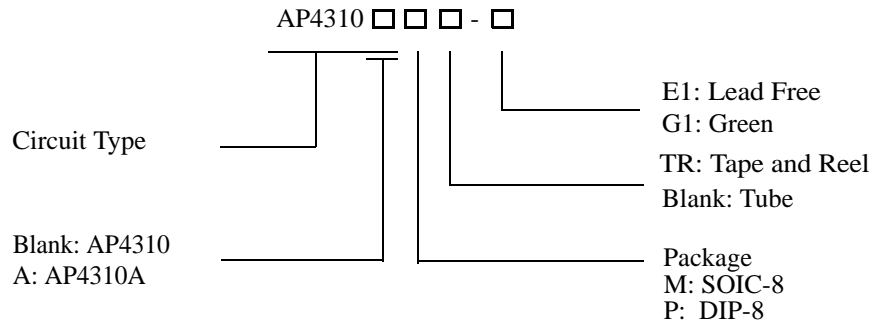
Figure 3. Functional Block Diagram of AP4310/A



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Ordering Information



Package	Reference Voltage	Voltage Tolerance	Temperature Range	Part Number		Marking ID		Packing Type
				Lead Free	Green	Lead Free	Green	
DIP-8	2.5V	± 0.4%	-40 to 105 °C	AP4310AP-E1	AP4310AP-G1	AP4310AP-E1	AP4310AP-G1	Tube
		± 1%		AP4310P-E1	AP4310P-G1	AP4310P-E1	AP4310P-G1	
SOIC-8	2.5V	± 0.4%	-40 to 105 °C	AP4310AM-E1	AP4310AM-G1	AP4310AM-E1	AP4310AM-G1	Tube
				AP4310AMTR-E1	AP4310AMTR-G1	AP4310AMTR-E1	AP4310AMTR-G1	Tape & Reel
		± 1%	-40 to 105 °C	AP4310M-E1	AP4310M-G1	AP4310M-E1	AP4310M-G1	Tube
				AP4310MTR-E1	AP4310MTR-G1	AP4310MTR-E1	AP4310MTR-G1	Tape & Reel

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant. Products with "G1" suffix are available in green packages.

**DUAL OP AMP AND VOLTAGE REFERENCE****AP4310/A****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 ($T_A=25^{\circ}\text{C}$)	P_D	DIP-8	800	mW
		SOIC-8	500	
Operating Junction Temperature	T_J	150	$^{\circ}\text{C}$	
Storage Temperature Range	T_{STG}	-65 to 150	$^{\circ}\text{C}$	
Lead Temperature (Soldering 10s)	T_{LEAD}	260	$^{\circ}\text{C}$	

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	$^{\circ}\text{C}$



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Electrical Characteristics

Operating Conditions: $V_{CC} = +5V$, $T_A = 25^\circ C$ unless otherwise specified.

Parameter	Conditions		Min	Typ	Max	Unit	
Total Supply Current, excluding Current in Voltage Reference	$V_{CC} = 5V$, no load, $-40^\circ C \leq T_A \leq 105^\circ C$			0.15	0.25	mA	
	$V_{CC} = 30V$, no load, $-40^\circ C \leq T_A \leq 105^\circ C$			0.20	0.30		
Voltage Reference Section							
Reference Voltage	AP4310A	$I_K = 10mA$	$T_A = 25^\circ C$	2.49	2.50	2.51	V
			$-40^\circ C \leq T_A \leq 105^\circ C$	2.48	2.50	2.52	
	AP4310		$T_A = 25^\circ C$	2.475	2.50	2.525	V
			$-40^\circ C \leq T_A \leq 105^\circ C$	2.45	2.50	2.55	
Reference Voltage Deviation Over Full Temperature Range	$I_K = 10mA$, $T_A = -40$ to $105^\circ C$			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 ($V_{CC} = 5V$, $V_O = 1.4V$, $T_A = 25^\circ C$, unless otherwise noted)							
Input Offset Voltage	$T_A = 25^\circ C$			0.5	3	mV	
	$T_A = -40$ to $105^\circ C$				5		
Input Offset Voltage Temperature Drift	$T_A = -40$ to $105^\circ C$			7		$\mu V/^\circ C$	
Input Bias Current (Inverting Input Only)	$T_A = 25^\circ C$			20	150	nA	
Large Signal Voltage Gain	$V_{CC} = 15V$, $R_L = 2k\Omega$, $V_O = 1.4$ 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)	$V_{CC} = 30V$, $R_L = 10k\Omega$, $V_{ID} = 1V$		27	28		V	
Output Voltage Swing (Low)	$V_{CC} = 30V$, $R_L = 10k\Omega$, $V_{ID} = -1V$			17	100	mV	
Slew Rate	$V_{CC} = 18V$, $R_L = 2k\Omega$, $A_V = 1$, $V_{IN} = 0.5$ to $2V$, $C_L = 100pF$		0.2	0.5		$V/\mu s$	
Unity Gain Bandwidth	$V_{CC} = 30V$, $R_L = 2k\Omega$, $C_L = 100pF$		0.7	1.0		MHz	



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Electrical Characteristics (Continued)

Operating Conditions: $V_{CC}=+5V$, $T_A=25^{\circ}C$ unless otherwise specified.

Parameter	Conditions	Min	Typ	Max	Unit
Op Amp 2 Section ($V_{CC}=5V$, $V_O=1.4V$, $T_A=25^{\circ}C$, unless otherwise noted)					
Input Offset Voltage	$T_A=25^{\circ}C$		0.5	3	mV
	$T_A=-40$ to $105^{\circ}C$			5	
Input Offset Voltage Temperature Drift	$T_A=-40$ to $105^{\circ}C$		7		$\mu V/^{\circ}C$
Input Offset Current	$T_A=25^{\circ}C$		2	30	nA
Input Bias Current	$T_A=25^{\circ}C$		20	150	nA
Input Voltage Range	$V_{CC}=0$ to $36V$	0		$V_{CC}-1.5$	V
Common Mode Rejection Ratio	$T_A=25^{\circ}C$, $V_{CM}=0$ to $3.5V$	70	85		dB
Large Signal Voltage Gain	$V_{CC}=15V$, $R_L=2k\Omega$, $V_O=1.4$ 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)	$V_{CC}=30V$, $R_L=10k\Omega$, $V_{ID}=1V$	27	28		V
Output Voltage Swing (Low)	$V_{CC}=30V$, $R_L=10k\Omega$, $V_{ID}=-1V$		17	100	mV
Slew Rate	$V_{CC}=18V$, $R_L=2k\Omega$, $A_V=1$, $V_{IN}=0.5$ to $2V$, $C_L=100pF$	0.2	0.5		$V/\mu s$
Unity Gain Bandwidth	$V_{CC}=30V$, $R_L=2k\Omega$, $C_L=100pF$	0.7	1.0		MHz



Typical Performance Characteristics

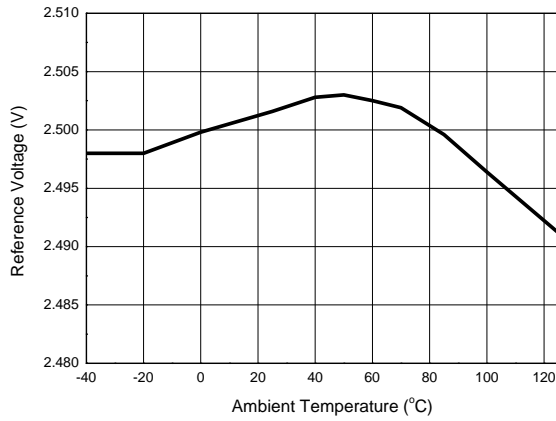


Figure 4. Reference Voltage vs. Ambient Temperature

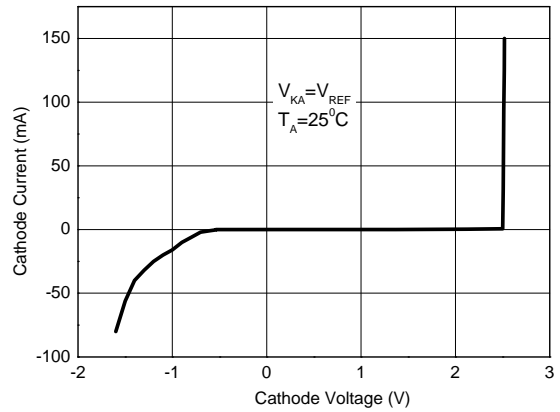


Figure 5. Cathode Current vs. Cathode Voltage

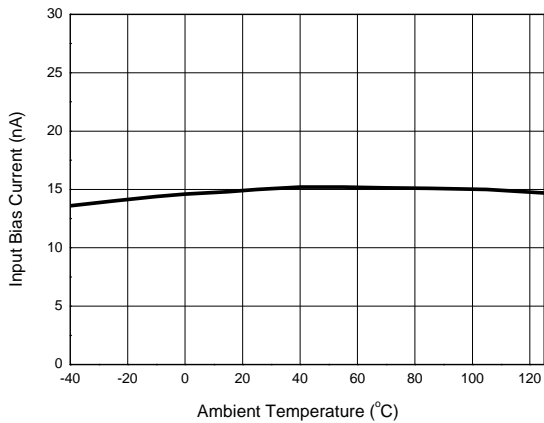


Figure 6. Input Bias Current vs. Ambient Temperature

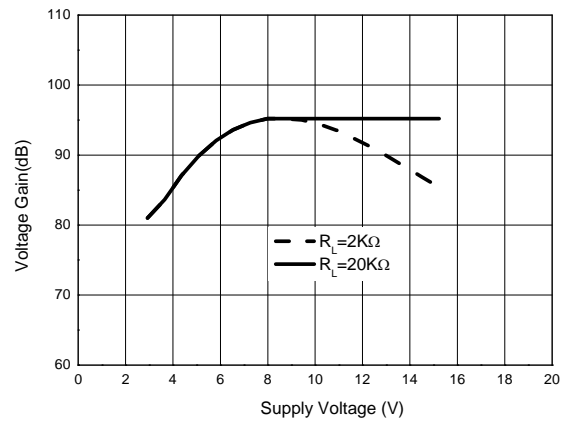


Figure 7. Op Amp Voltage Gain

Typical Application

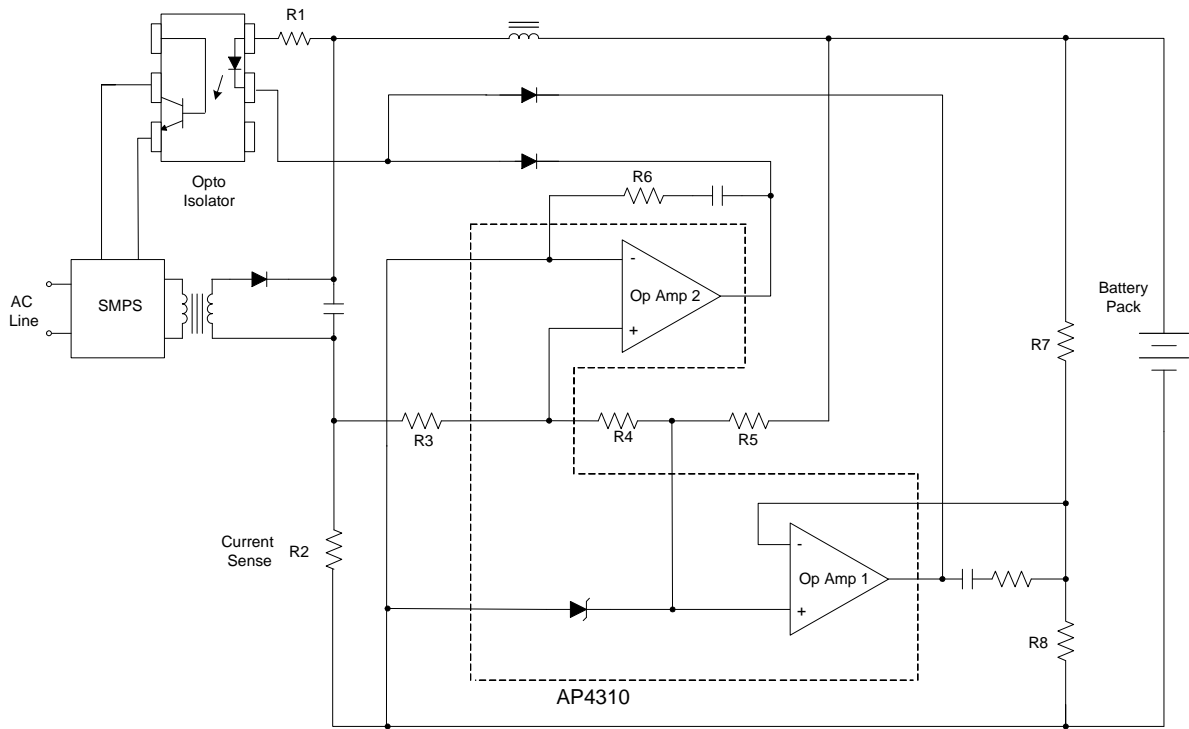


Figure 8. Application of AP4310/A in a Constant Current and Constant Voltage Charger



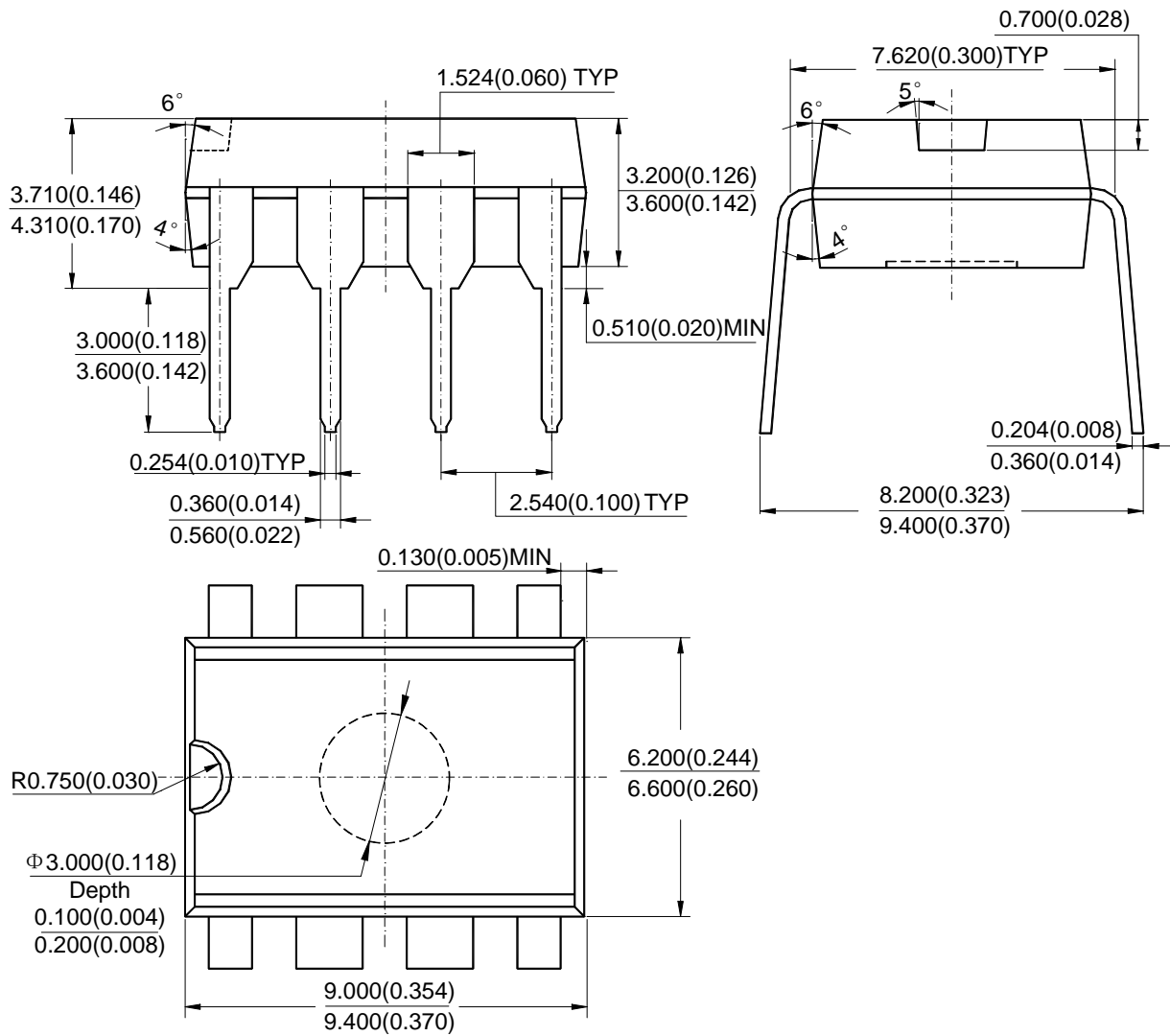
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Mechanical Dimensions:

DIP-8

Unit: mm(inch)





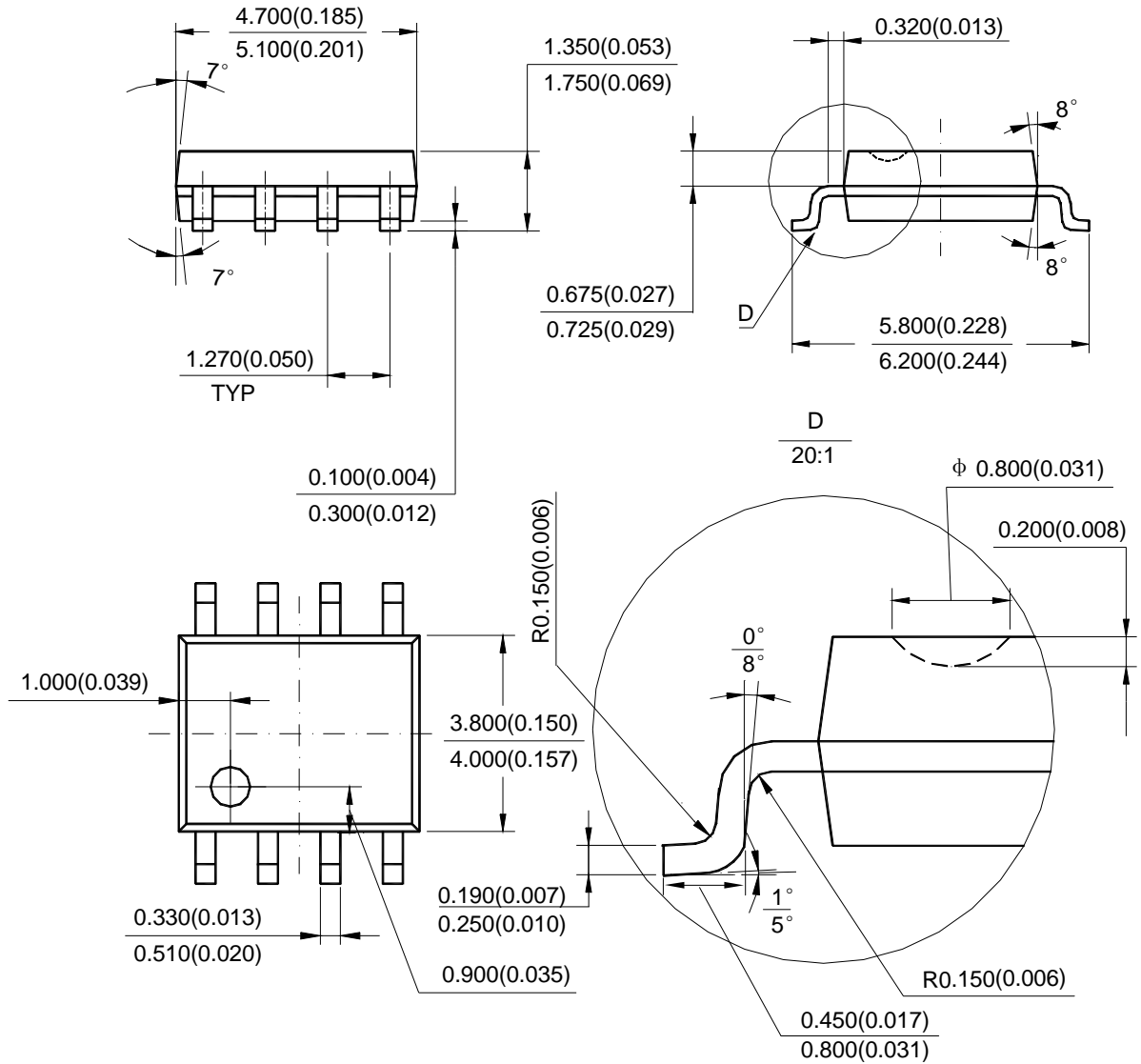
DUAL OP AMP AND VOLTAGE REFERENCE

AP4310/A

Mechanical Dimensions (Continued):

SOIC-8

Unit: mm(inch)





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