

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: 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
- Voltage Tolerance: $\pm 0.4\%$, $\pm 1\%$
- Sink Current Capability: 0.05 to 80mA
- Typical Output Impedance: 0.2 Ω

Applications

- Battery Charger
- Switching Power Supply

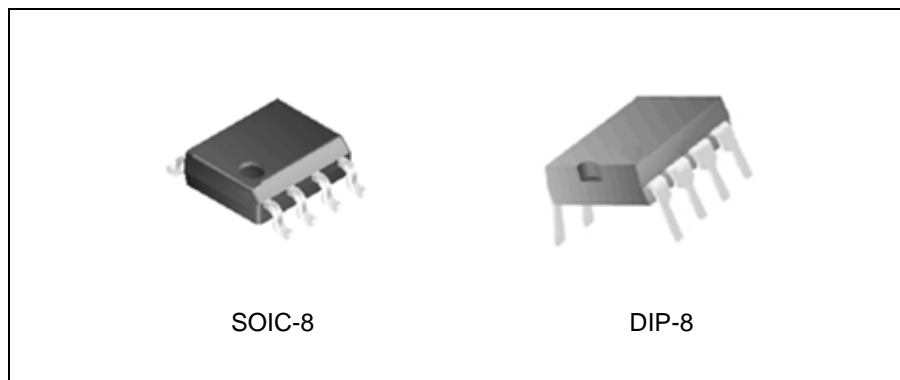


Figure 1. Package Types of AP4310

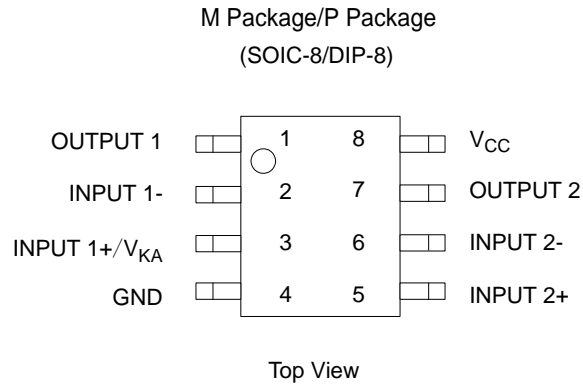
Pin Configuration


Figure 2. Pin Configuration of AP4310

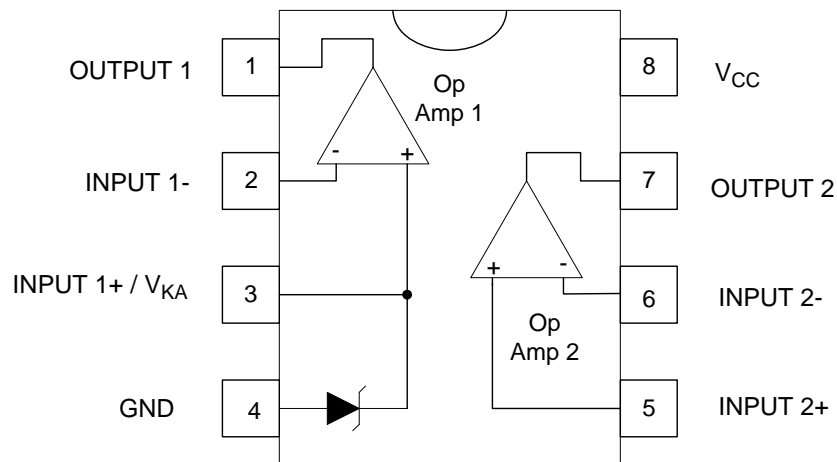
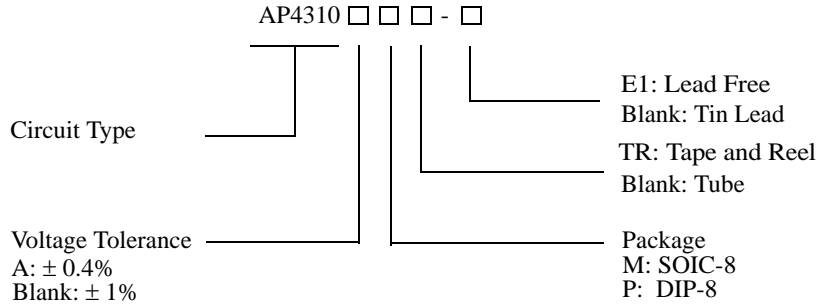
Functional Block Diagram


Figure 3. Functional Block Diagram of AP4310



DUAL OP AMP AND VOLTAGE REFERENCE **AP4310**

Ordering Information



| Package | Reference Voltage | Voltage Tolerance | Temperature Range | Part Number | | Marking ID | | Packing Type |
|---------|-------------------|-------------------|-------------------|-------------|---------------|------------|-------------|--------------|
| | | | | Tin Lead | Lead Free | Tin Lead | Lead Free | |
| DIP-8 | 2.5V | ± 0.4% | -40 to 105°C | AP4310AP | AP4310AP-E1 | AP4310AP | AP4310AP-E1 | Tube |
| | | ± 1% | | AP4310P | AP4310P-E1 | AP4310P | AP4310P-E1 | |
| SOIC-8 | 2.5V | ± 0.4% | -40 to 105°C | AP4310AM | AP4310AM-E1 | 4310AM | AP4310AM-E1 | Tube |
| | | | | AP4310AMTR | AP4310AMTR-E1 | 4310AM | AP4310AM-E1 | Tape & Reel |
| | | ± 1% | -40 to 105°C | AP4310M | AP4310M-E1 | 4310M | AP4310M-E1 | Tube |
| | | | | AP4310MTR | AP4310MTR-E1 | 4310M | AP4310M-E1 | Tape & Reel |

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

**DUAL OP AMP AND VOLTAGE REFERENCE****AP4310****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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AP4310

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

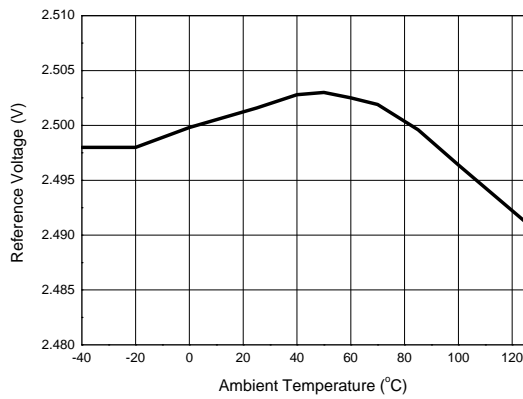


Figure 4. Reference Voltage vs. Ambient Temperature

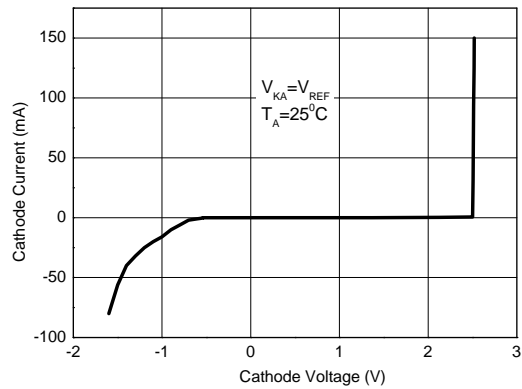


Figure 5. Cathode Current vs. Cathode Voltage

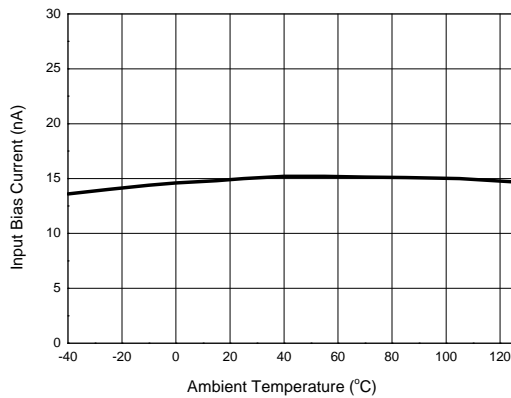


Figure 6. Input Bias Current vs. Ambient Temperature

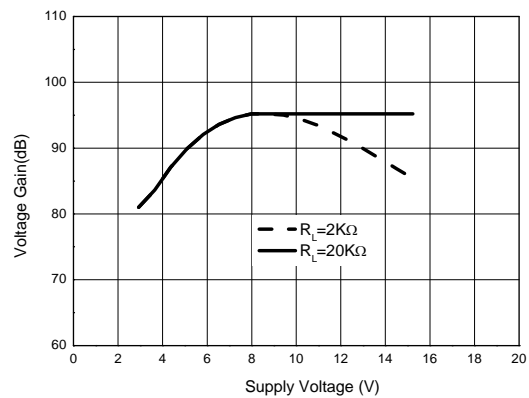


Figure 7. Op Amp Voltage Gain

Typical Application

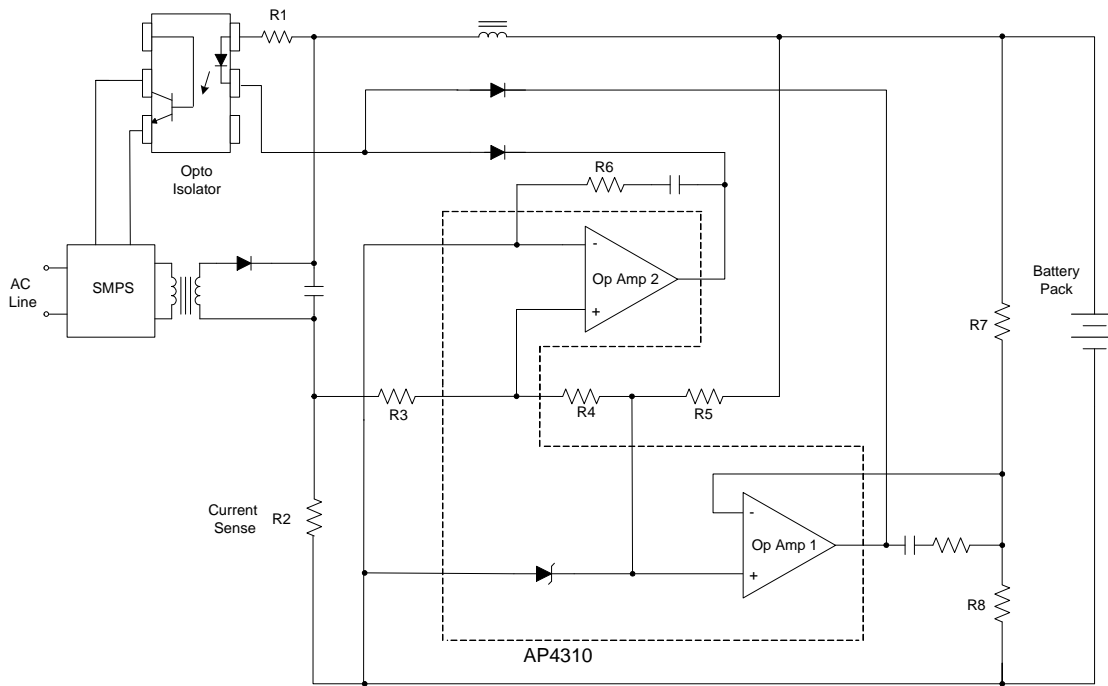


Figure 8. Application of AP4310 in a Constant Current and Constant Voltage Charger

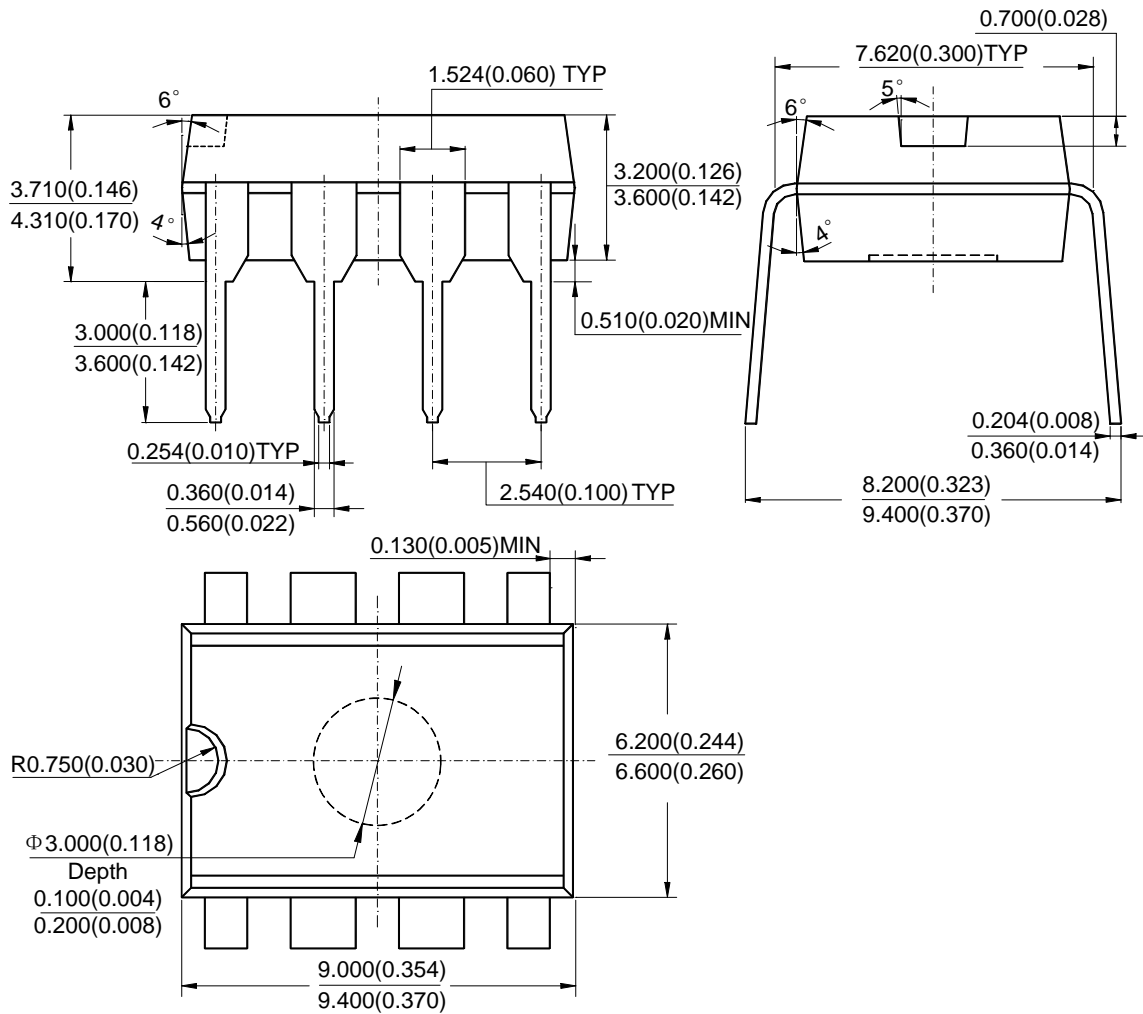
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Mechanical Dimensions:

DIP-8

Unit: mm(inch)





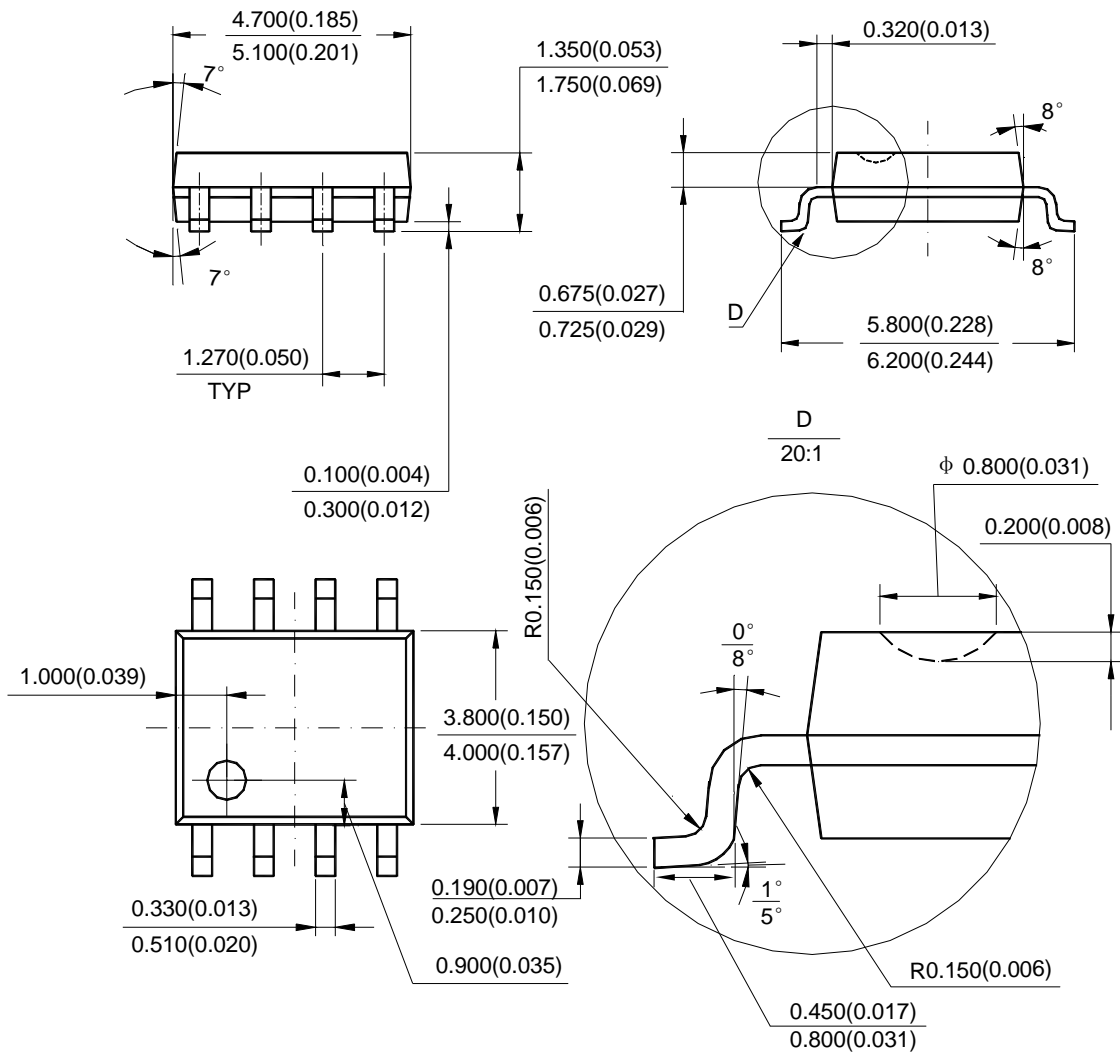
DUAL OP AMP AND VOLTAGE REFERENCE

AP4310

Mechanical Dimensions (Continued):

SOIC-8

Unit: mm(inch)





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