

**DUAL OP AMP AND VOLTAGE REFERENCE****AP4300****General Description**

The AP4300 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 operational amplifiers and a precision shunt regulator. Op Amp 1 is designed for voltage control, whose 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 AP4300 is available in standard packages of DIP-8 and SOIC-8.

**Features****Op Amp**

- Input Offset Voltage: 0.5mV
- Supply Current: 250 $\mu$ 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 18V

**Voltage Reference**

- Fixed Output Voltage Reference: 2.5V, 2.6V
- Voltage Tolerance: 0.5%, 1%
- Sink Current Capability from 0.1 to 80mA

**Applications**

- Battery Charger
- Switching Power Supply

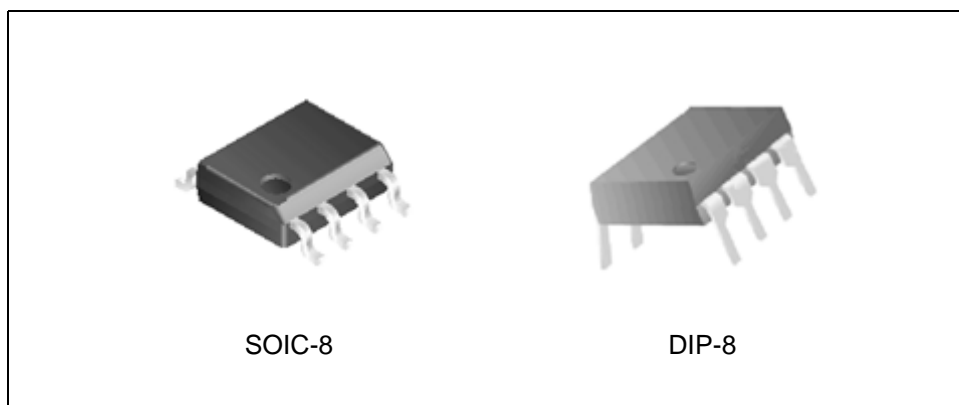


Figure 1. Package Types of AP4300



**DUAL OP AMP AND VOLTAGE REFERENCE**

**AP4300**

**Pin Configuration**

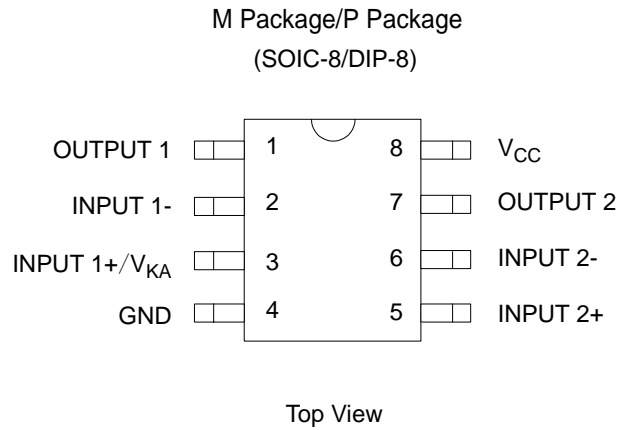


Figure 2. Pin Configuration of AP4300

**Functional Block Diagram**

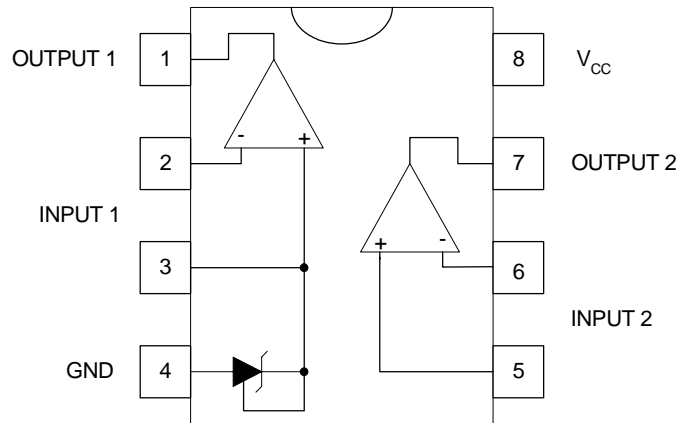


Figure 3. Functional Block Diagram of AP4300



**DUAL OP AMP AND VOLTAGE REFERENCE**

**AP4300**

**Functional Block Diagram (Continued)**

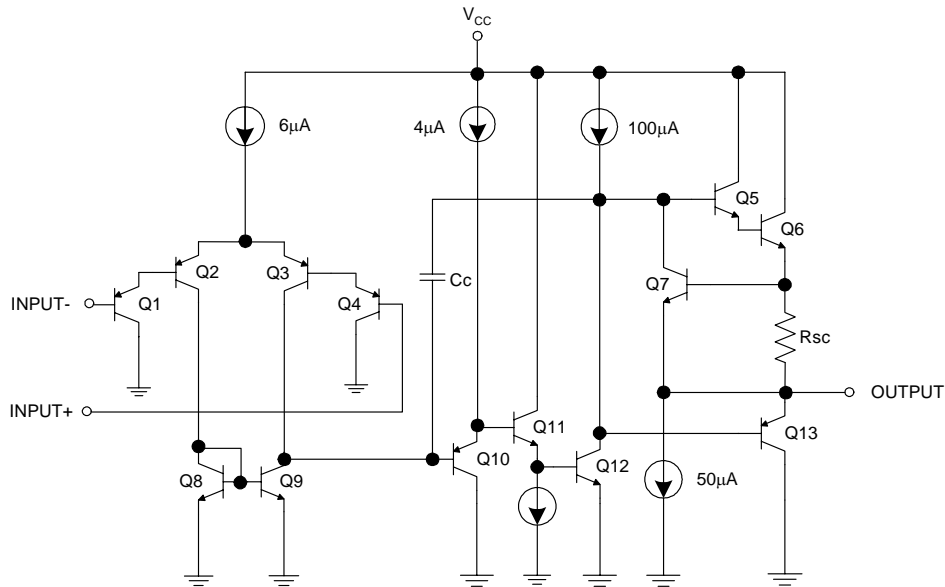


Figure 4. Op Amp Functional Block Diagram  
(Each Amplifier)

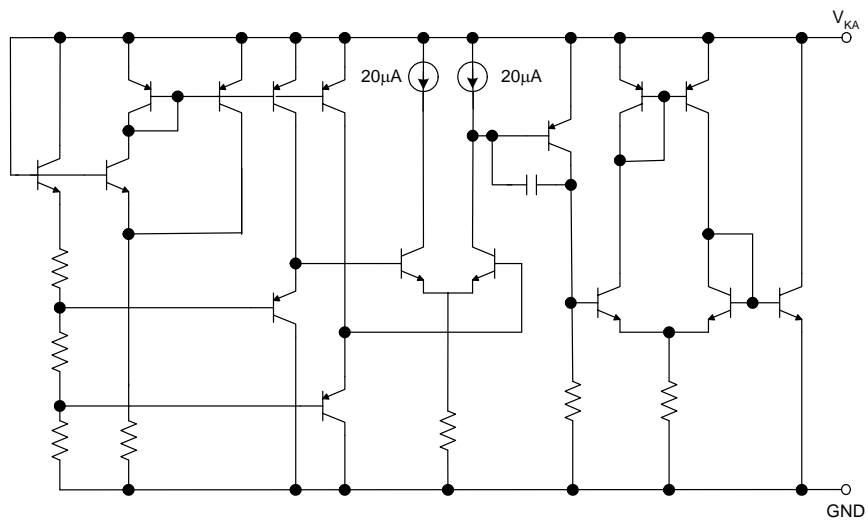


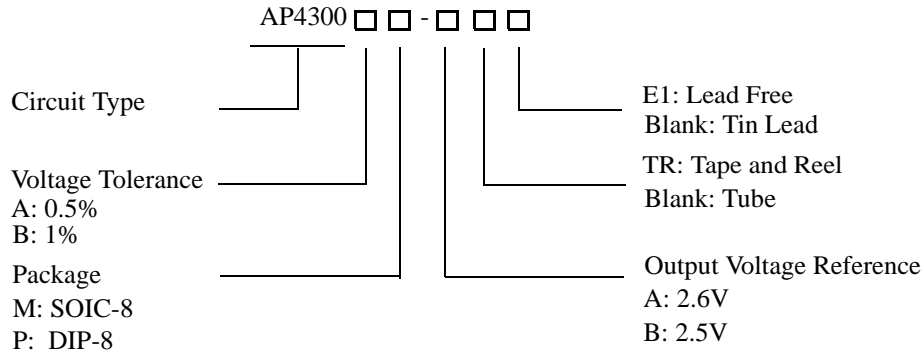
Figure 5. Voltage Reference Functional Block Diagram



**DUAL OP AMP AND VOLTAGE REFERENCE**

**AP4300**

**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	2.6V	0.5%	-40 to 105°C	AP4300AP-A	AP4300AP-AE1	AP4300AP-A	AP4300AP-AE1	Tube
		1%		AP4300BP-A	AP4300BP-AE1	AP4300BP-A	AP4300BP-AE1	
	2.5V	0.5%		AP4300AP-B	AP4300AP-BE1	AP4300AP-B	AP4300AP-BE1	
		1%		AP4300BP-B	AP4300BP-BE1	AP4300BP-B	AP4300BP-BE1	
SOIC-8	2.6V	0.5%	-40 to 105°C	AP4300AM-A	AP4300AM-AE1	AP4300AM-A	AP4300AM-AE1	Tube
				AP4300AM-ATR	AP4300AM-ATRE1	AP4300AM-A	AP4300AM-AE1	Tape & Reel
		1%		AP4300BM-A	AP4300BM-AE1	AP4300BM-A	AP4300BM-AE1	Tube
				AP4300BM-ATR	AP4300BM-ATRE1	AP4300BM-A	AP4300BM-AE1	Tape & Reel
	2.5V	0.5%		AP4300AM-B	AP4300AM-BE1	AP4300AM-B	AP4300AM-BE1	Tube
				AP4300AM-BTR	AP4300AM-BTRE1	AP4300AM-B	AP4300AM-BE1	Tape & Reel
		1%		AP4300BM-B	AP4300BM-BE1	AP4300BM-B	AP4300BM-BE1	Tube
				AP4300BM-BTR	AP4300BM-BTRE1	AP4300BM-B	AP4300BM-BE1	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****AP4300****Absolute Maximum Ratings (Note 1)**

Parameter	Symbol	Value	Unit
Power Supply Voltage ( $V_{CC}$ to GND)	$V_{CC}$	20	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)	$V_{ID}$	20	V
Voltage Reference Cathode Current (Pin 3)	$I_K$	100	mA
Power Dissipation ( $T_A=25^\circ\text{C}$ )	$P_D$	DIP-8	800
		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)	$T_L$	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	18	V
Ambient Temperature	-40	105	$^\circ\text{C}$



**DUAL OP AMP AND VOLTAGE REFERENCE**

**AP4300**

**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, $-40^{\circ}C \leq T_A \leq 105^{\circ}C$		0.5	0.8	mA	
	$V_{CC}=18V$ , no load, $-40^{\circ}C \leq T_A \leq 105^{\circ}C$		0.6	1.2		
<b>Voltage Reference Section</b>						
Reference Voltage for AP4300-A	$I_K=10mA$ , $T_A=25^{\circ}C$	0.5% tolerance	2.587	2.600	2.613	V
		1% tolerance	2.574		2.626	
Reference Voltage for AP4300-B	$I_K=10mA$ , $T_A=25^{\circ}C$	0.5% tolerance	2.487	2.500	2.513	V
		1% tolerance	2.475		2.525	
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			0.1	1	mA	
Dynamic Impedance	$I_K=1.0$ to $80mA$ , $f < 1kHz$		0.2	0.5	$\Omega$	
<b>Op Amp 1 Section (<math>V_{CC}=5V</math>, <math>V_O=1.4V</math>, <math>T_A=25^{\circ}C</math>, unless otherwise noted)</b>						
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 $18V$	70	90		dB	
Output Current	Source	$V_{CC}=15V$ , $V_{ID}=1V$ , $V_O=2V$	20	40	mA	
	Sink	$V_{CC}=15V$ , $V_{ID}=-1V$ , $V_O=2V$	10	20	mA	
Output Voltage Swing (High)	$V_{CC}=18V$ , $R_L=10K\Omega$ , $V_{ID}=1V$	16	16.5		V	
Output Voltage Swing (Low)	$V_{CC}=18V$ , $R_L=10K\Omega$ , $V_{ID}=-1V$		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		$V/\mu s$	
Gain Bandwidth Product	$V_{CC}=18V$ , $R_L=2k\Omega$ , $C_L=100pF$ , $V_{IN}=10mV$ , $f=100kHz$	0.7	1		MHz	



**DUAL OP AMP AND VOLTAGE REFERENCE**

**AP4300**

**Electrical Characteristics (Continued)**

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

Parameter	Conditions	Min	Typ	Max	Unit
<b>Op Amp 2 Section (<math>V_{CC}=5V</math>, <math>V_O=1.4V</math>, <math>T_A=25^{\circ}C</math>, unless otherwise noted)</b>					
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 $18V$	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 $18V$	70	90		dB
Output Current	Source $V_{CC}=15V$ , $V_{ID}=1V$ , $V_O=2V$	20	40		mA
	Sink $V_{CC}=15V$ , $V_{ID}=-1V$ , $V_O=2V$	10	20		mA
Output Voltage Swing (High)	$V_{CC}=18V$ , $R_L=10k\Omega$ , $V_{ID}=1V$	16	16.5		V
Output Voltage SWing (Low)	$V_{CC}=18V$ , $R_L=10k\Omega$ , $V_{ID}=-1V$		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		$V/\mu s$
Gain Bandwidth Product	$V_{CC}=18V$ , $R_L=2k\Omega$ , $C_L=100pF$ , $V_{IN}=10mV$ , $f=100kHz$	0.7	1		MHz



**DUAL OP AMP AND VOLTAGE REFERENCE**

**AP4300**

**Typical Performance Characteristics**

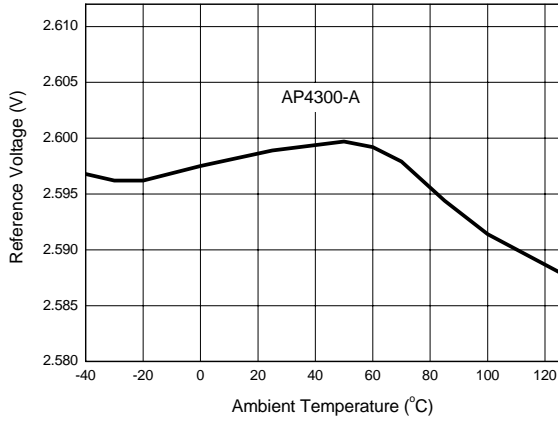


Figure 6. Reference Voltage vs. Ambient Temperature

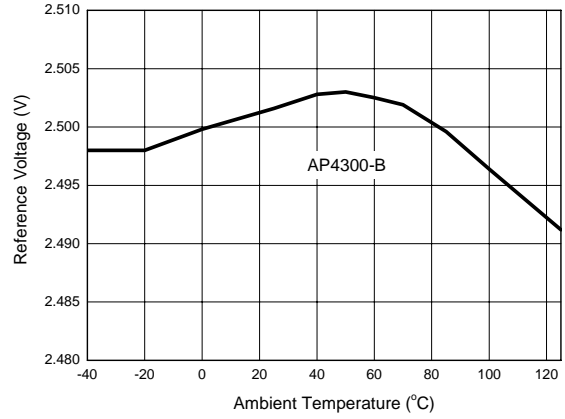


Figure 7. Reference Voltage vs. Ambient Temperature

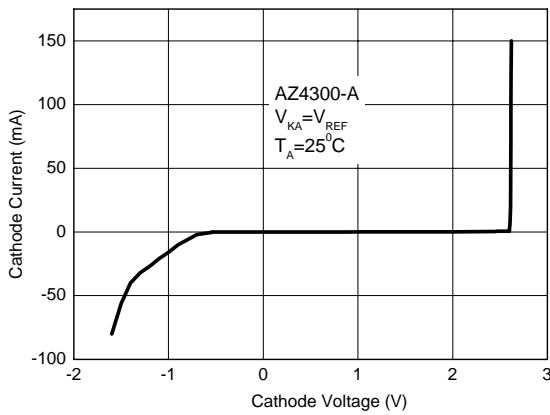


Figure 8. Cathode Current vs. Cathode Voltage

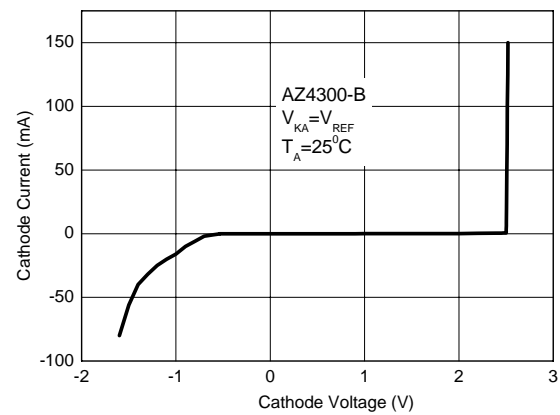


Figure 9. Cathode Current vs. Cathode Voltage

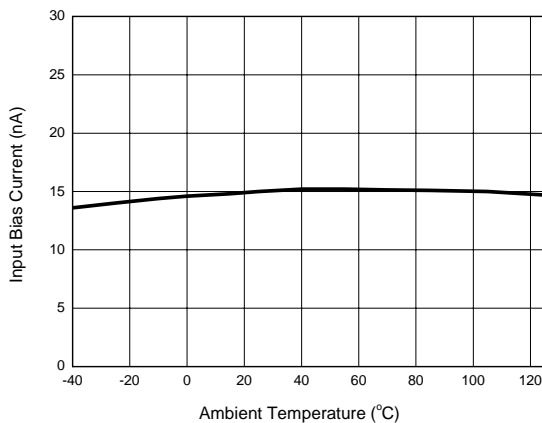


Figure 10. Input Bias Current vs. Ambient Temperature

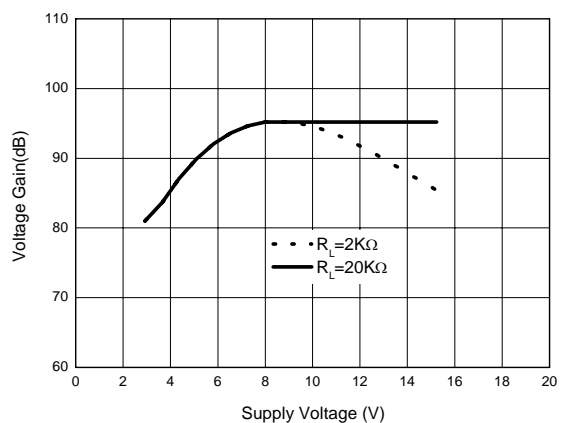


Figure 11. Operational Amplifier Voltage Gain









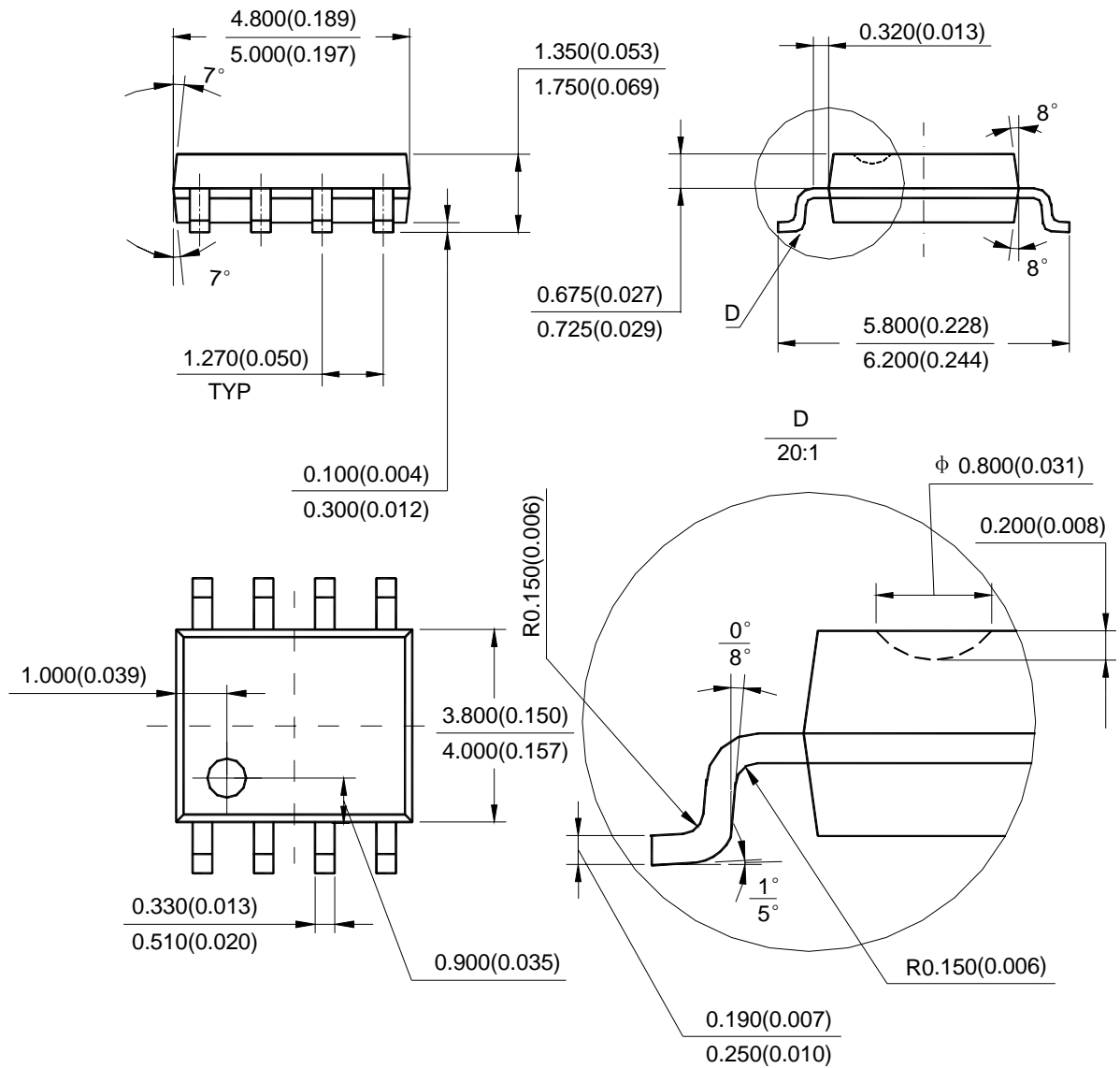
**DUAL OP AMP AND VOLTAGE REFERENCE**

**AP4300**

**Mechanical Dimensions (Continued)**

**SOIC-8**

**Unit: mm(inch)**





BCD Semiconductor Manufacturing Limited

<http://www.bcdsemi.com>

### IMPORTANT NOTICE

BCD Semiconductor Manufacturing Limited reserves the right to make changes without further notice to any products or specifications herein. BCD Semiconductor Manufacturing Limited does not assume any responsibility for use of any its products for any particular purpose, nor does BCD Semiconductor Manufacturing Limited assume any liability arising out of the application or use of any its products or circuits. BCD Semiconductor Manufacturing Limited does not convey any license under its patent rights or other rights nor the rights of others.

---

#### MAIN SITE

**BCD Semiconductor Manufacturing Limited**  
- Wafer Fab  
Shanghai SIM-BCD Semiconductor Manufacturing Limited  
800, Yi Shan Road, Shanghai 200233, China  
Tel: +86-21-6485 1491, Fax: +86-21-5450 0008

**BCD Semiconductor Manufacturing Limited**  
- IC Design Group  
Advanced Analog Circuits (Shanghai) Corporation  
8F, Zone B, 900, Yi Shan Road, Shanghai 200233, China  
Tel: +86-21-6495 9539, Fax: +86-21-6485 9673

#### REGIONAL SALES OFFICE

**Shenzhen Office**  
Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd. Shenzhen Office  
Advanced Analog Circuits (Shanghai) Corporation Shenzhen Office  
27B, Tower C, 2070, Middle Shen Nan Road, Shenzhen 518031, China  
Tel: +86-755-8368 3987, Fax: +86-755-8368 3166

**Taiwan Office**  
BCD Semiconductor (Taiwan) Company Limited  
4F, 298-1, Rui Guang Road, Nei-Hu District, Taipei,  
Taiwan  
Tel: +886-2-2656 2808, Fax: +886-2-2656 2806

**USA Office**  
BCD Semiconductor Corporation  
3170 De La Cruz Blvd., Suite 105, Santa Clara,  
CA 95054-2411, U.S.A  
Tel: +1-408-988 6388, Fax: +1-408-988 6386