DUAL OP AMP AND VOLTAGE REFERENCE AP4301

General Description

The AP4301 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 AP4301 is available in standard packages of DIP-8 and SOIC-8.

Features

Op Amp

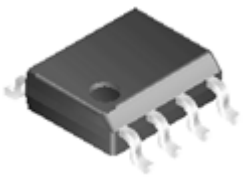
- Input Offset Voltage: 0.5mV
- Supply Current: 250μA per Op-Amp at 5.0V Supply Voltage
- Unity Gain Bandwidth: 1MHz
- Output Voltage Swing: 0 to (V_{CC}-1.5)V
- Power Supply Range: 3 to 18V

Voltage Reference

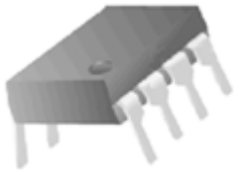
- Fixed Output Voltage Reference: 1.25V, 1.24V
- Voltage Tolerance: 0.5%, 1%
- Sink Current Capability from 0.1 to 80mA

Applications

- Battery Charger
- Switching Power Supply



SOIC-8

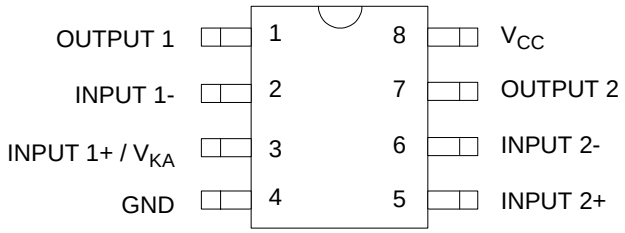


DIP-8

Figure 1. Package Types of AP4301

Pin Configuration

M Package/P Package
(SOIC-8/DIP-8)



Top View

Figure 2. Pin Configuration of AP4301

Functional Block Diagram

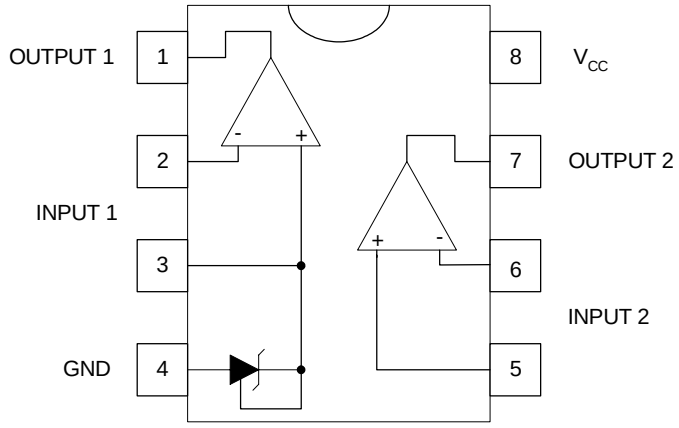


Figure 3. Functional Block Diagram of AP4301

Functional Block Diagram (Continued)

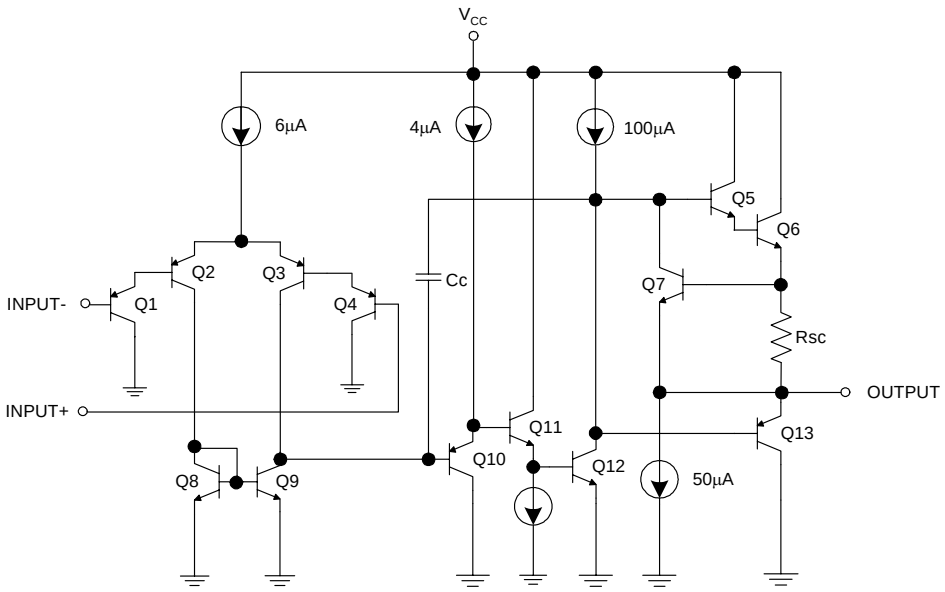


Figure 4. Op Amp Functional Block Diagram
(Each Amplifier)

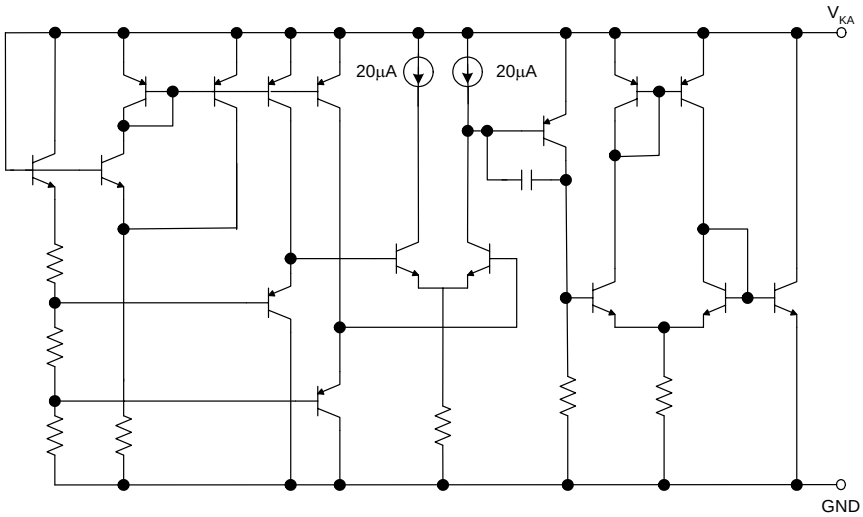
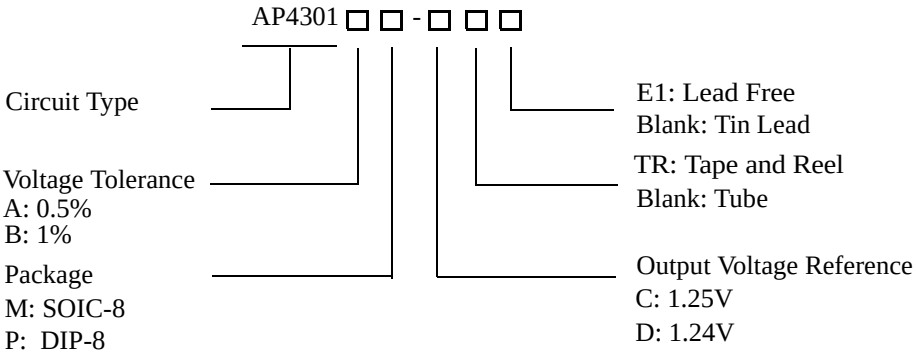


Figure 5. Voltage Reference Functional Block Diagram

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	1.25V	0.5%	-40 to 85°C	AP4301AP-C	AP4301AP-CE1	AP4301AP-C	AP4301AP-CE1	Tube
		1%		AP4301BP-C	AP4301BP-CE1	AP4301BP-C	AP4301BP-CE1	
	1.24V	0.5%		AP4301AP-D	AP4301AP-DE1	AP4301AP-D	AP4301AP-DE1	
		1%		AP4301BP-D	AP4301BP-DE1	AP4301BP-D	AP4301BP-DE1	
SOIC-8	1.25V	0.5%	-40 to 85°C	AP4301AM-C	AP4301AM-CE1	AP4301AM-C	AP4301AM-CE1	Tube
				AP4301AM-CTR	AP4301AM-CTRE1	AP4301AM-C	AP4301AM-CE1	Tape & Reel
		1%		AP4301BM-C	AP4301BM-CE1	AP4301BM-C	AP4301BM-CE1	Tube
				AP4301BM-CTR	AP4301BM-CTRE1	AP4301BM-C	AP4301BM-CE1	Tape & Reel
	1.24V	0.5%		AP4301AM-D	AP4301AM-DE1	AP4301AM-D	AP4301AM-DE1	Tube
				AP4301AM-DTR	AP4301AM-DTRE1	AP4301AM-D	AP4301AM-DE1	Tape & Reel
		1%		AP4301BM-D	AP4301BM-DE1	AP4301BM-D	AP4301BM-DE1	Tube
				AP4301BM-DTR	AP4301BM-DTRE1	AP4301BM-D	AP4301BM-DE1	Tape/ Reel

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

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	P_D	DIP-8	800	mW
		SOIC-8	500	
Operating Junction Temperature	T_J	150		°C
Storage Temperature Range	T_{STG}	-65 to 150		°C
Lead Temperature (Soldering 10s)	T_L	260		°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	85	°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≤85°C			0.5	0.8	mA
		V_{CC}=18V, no load, -40°C≤T_A≤85°C			0.6	1.2	
Voltage Reference Section							
Refeence Voltage for AP4301-C		I_K=10mA, T_A=25°C	0.5% tolerance	1.244	1.250	1.256	V
			1% tolerance	1.237		1.263	
Reference Voltage for AP4301-D		I_K=10mA, T_A=25°C	0.5% tolerance	1.234	1.240	1.246	V
			1% tolerance	1.227		1.252	
Reference Voltage Deviation over Full Temperature Range		I_K=10mA, T_A=-40 to 85°C			5	17	mV
Minimum Cathode Current for Regulation					0.2	1	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°C, unless otherwise noted)							
Input Offset Voltage		T_A=25°C			0.5	3	mV
		T_A=-40 to 85°C				5	
Input Offset Voltage Temperature Drift		T_A=-40 to 85°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 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=10KΩ, V_{ID}=1V		16	16.5		V
Output Voltage Swing (Low)		V_{CC}=18V, 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
Gain Bandwidth Product		V_{CC}=18V, R_L=2kΩ, C_L=100pF, V_{IN}=10mV, f=100kHz		0.7	1		MHz

Electrical Characteristics (Continued)

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

Parameter		Conditions	Min	Typ	Max	Unit
Op Amp2 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 to 85°C			5	
Input Offset Voltage Temperature Drift		T_A=-40 to 85°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 18V	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 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=10kΩ, V_{ID}=1V	16	16.5		V
Output Voltage SWing (Low)		V_{CC}=18V, 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
Gain Bandwidth Product		V_{CC}=18V, R_L=2kΩ, C_L=100pF, V_{IN}=10mV, f=100kHz	0.7	1		MHz

Typical Performance Characteristics

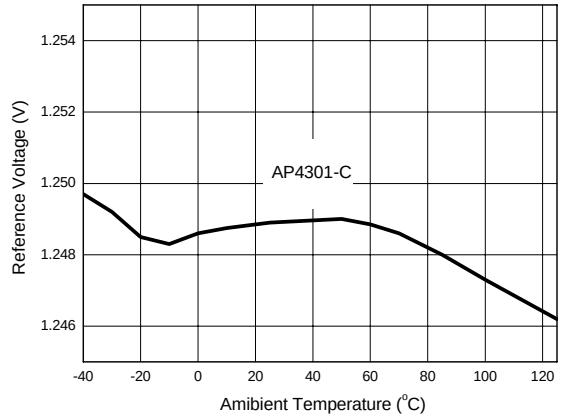


Figure 6. Reference Voltage vs. Ambient Temperature

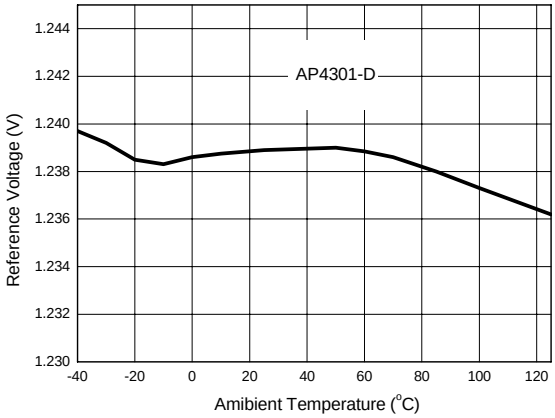


Figure 7. Reference Voltage vs. Ambient Temperature

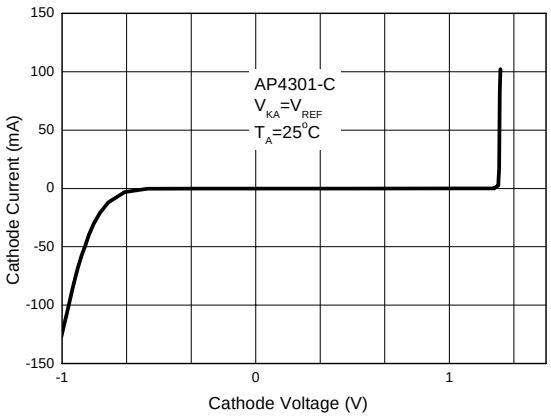


Figure 8. Cathode Current vs. Cathode Voltage

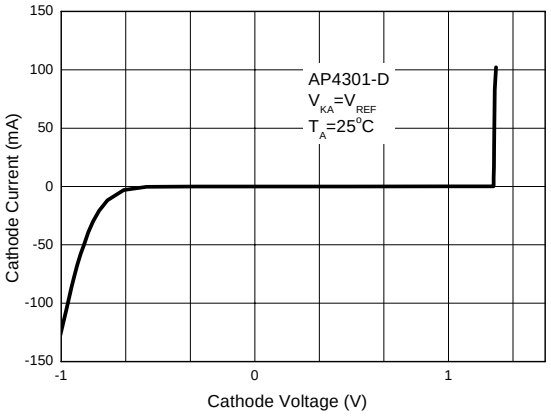


Figure 9. Cathode Current vs. Cathode Voltage

Typical Performance Characteristics (Continued)

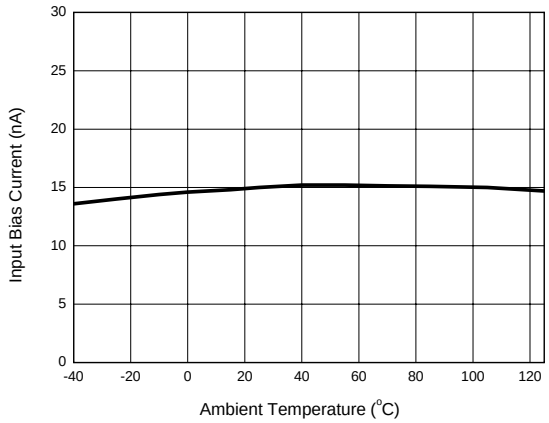


Figure10. Input Bias Current vs. Ambient Temperature

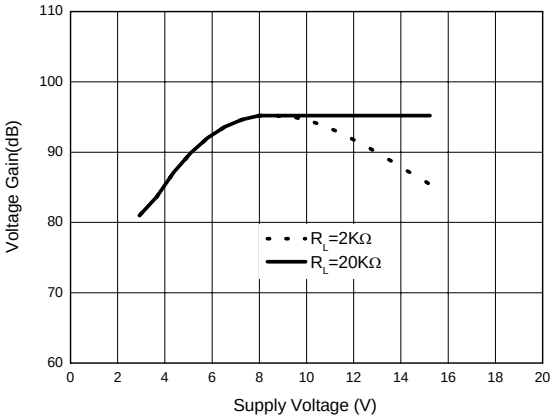


Figure 11. Op Amp Voltage Gain

Typical Application

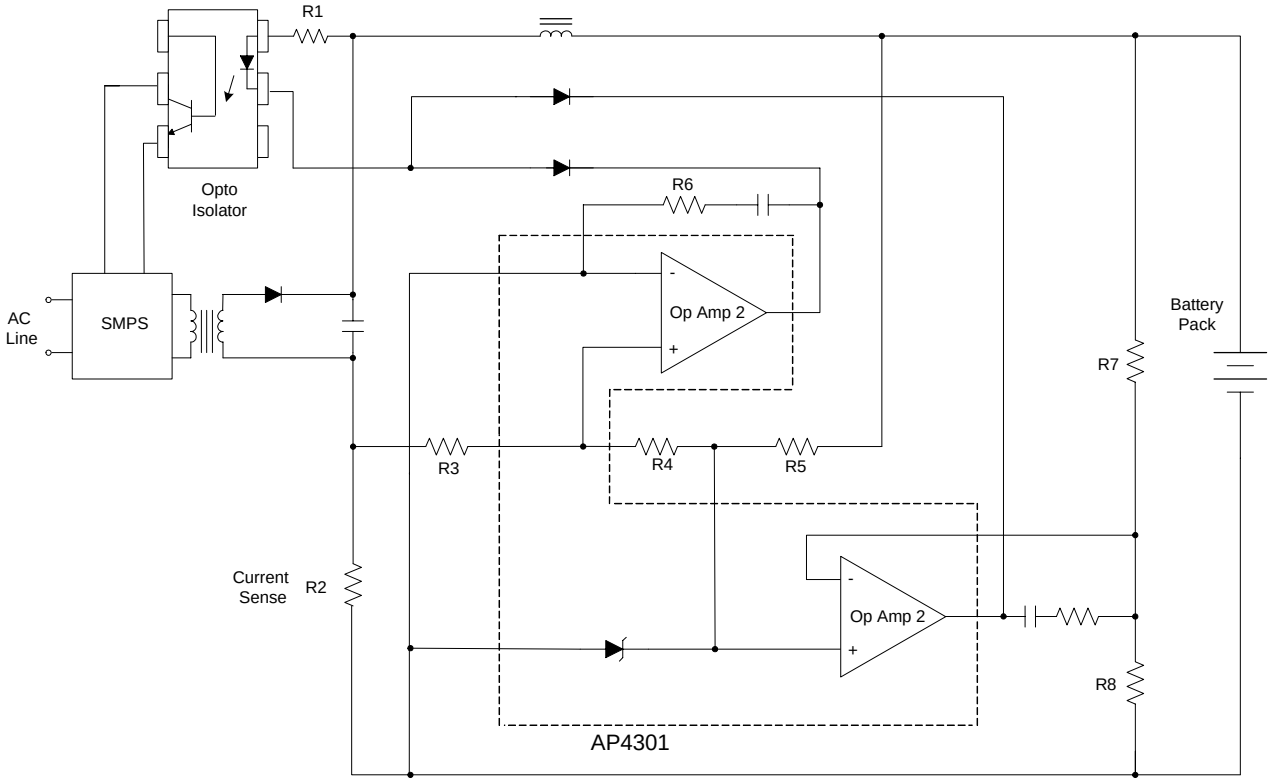
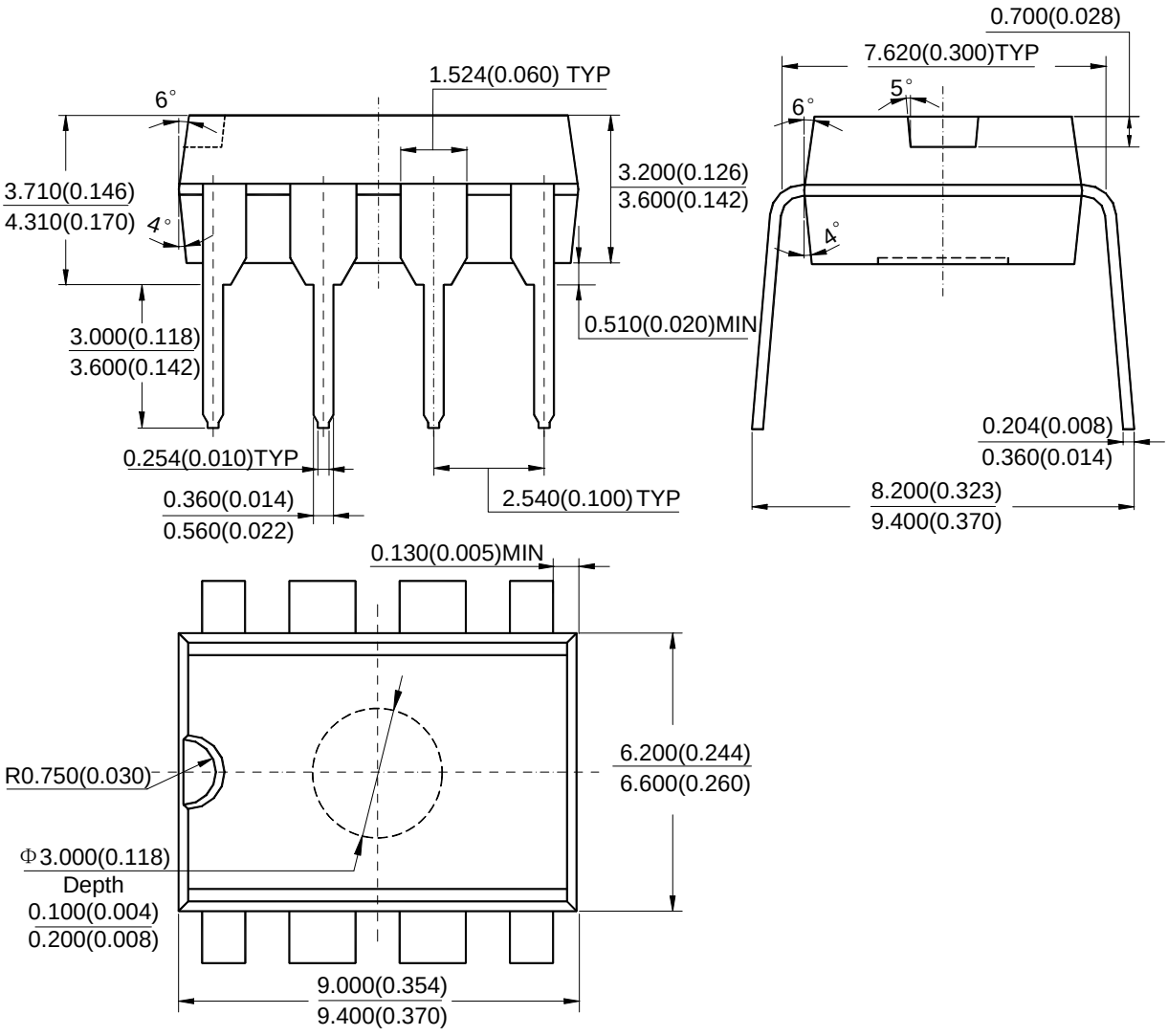


Figure 12. Application of AP4301 in a Constant Current and Constant Voltage Charger

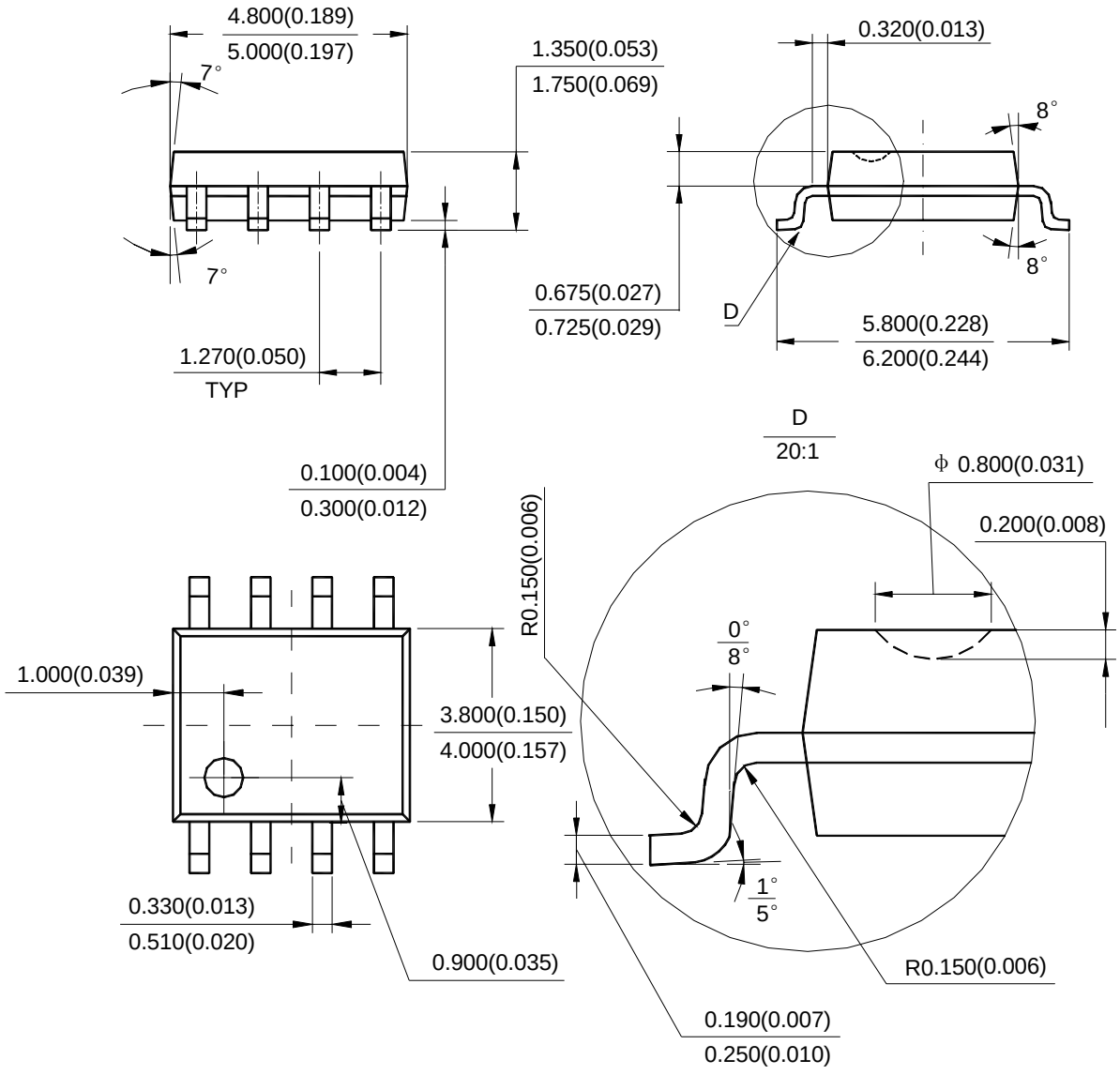
Mechanical Dimensions

DIP-8 **Unit: mm(inch)**



Mechanical Dimensions (Continued)

SOIC-8 **Unit: mm(inch)**



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