

**QUAD OP AMP AND VOLTAGE REFERENCE****AP4303****General Description**

The AP4303 is a monolithic IC that contains quad operational amplifiers and a precision shunt regulator, 1.25V for AP4303-C or 1.24V for AP4303-D respectively. It is specifically designed to regulate the output current and voltage levels of switching battery chargers and power supplies.

The four Op Amps feature accurate voltage and current control. Combining a stable voltage reference with the four Op Amps makes AP4303 ideal for use in multi-function charger, power supply voltage monitor, signal processing and control system.

The IC offers the power converter designer a control solution that features increased precision with a corresponding reduction in system complexity and cost.

The AP4303 is available in standard packages of DIP-16 and SOIC-16.

Features**Op Amp**

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

Voltage Reference

- Reference Voltage Tolerance: 0.5%, 1%
- Sink Current Capability from 0.1 to 80mA
- Output Dynamic Impedance: 0.2 Ω
- Externally Adjusted Output Voltage Reference: 1.25V for AP4303-C and 1.24V for AP4303-D

Applications

- Battery Charger
- Switching Power Supply

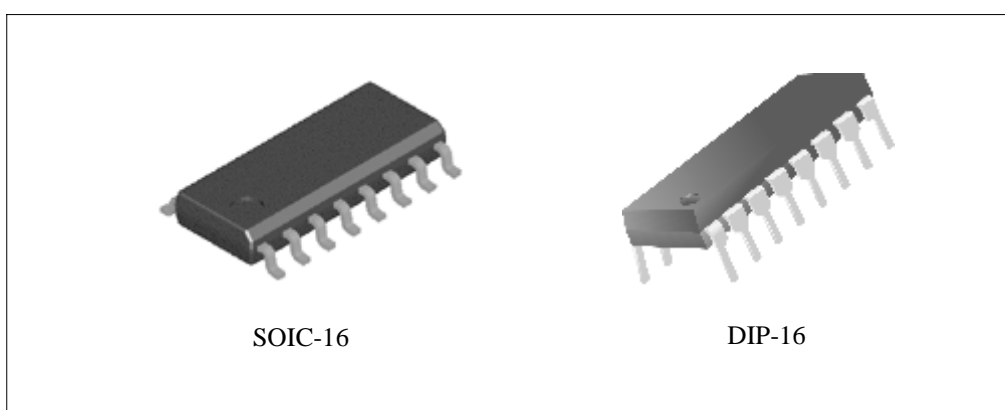


Figure 1. Package Types of AP4303

QUAD OP AMP AND VOLTAGE REFERENCE

AP4303

Pin Configuration

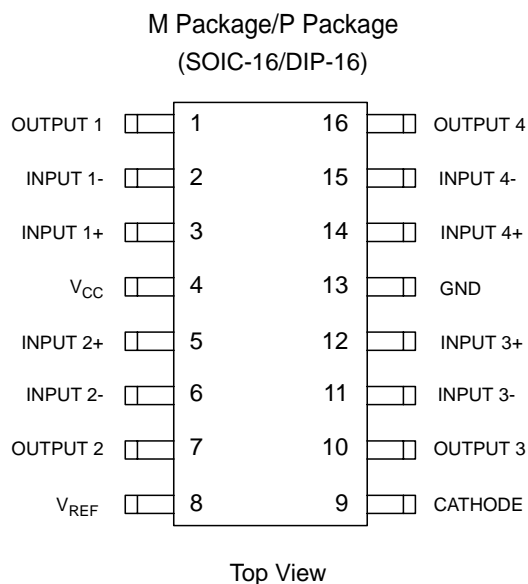


Figure 2. Pin configuration of AP4303

Functional Block Diagram

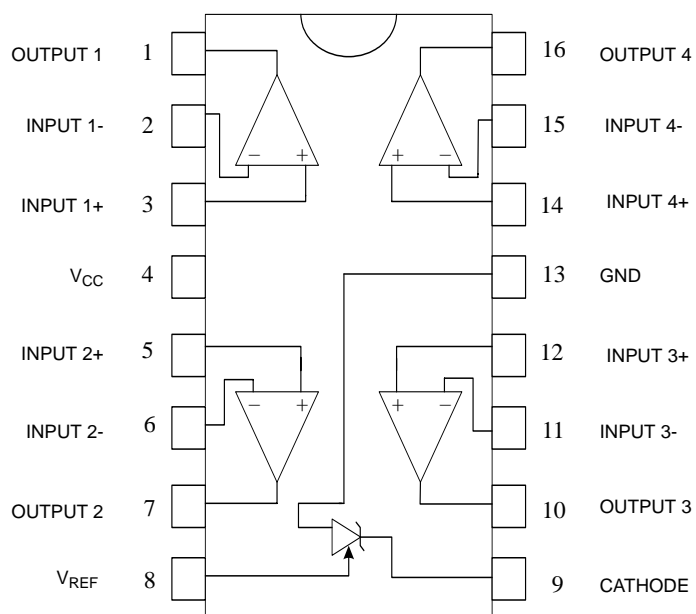


Figure 3. Functional Block Diagram of AP4303



QUAD OP AMP AND VOLTAGE REFERENCE

AP4303

Functional Block Diagram (Continued)

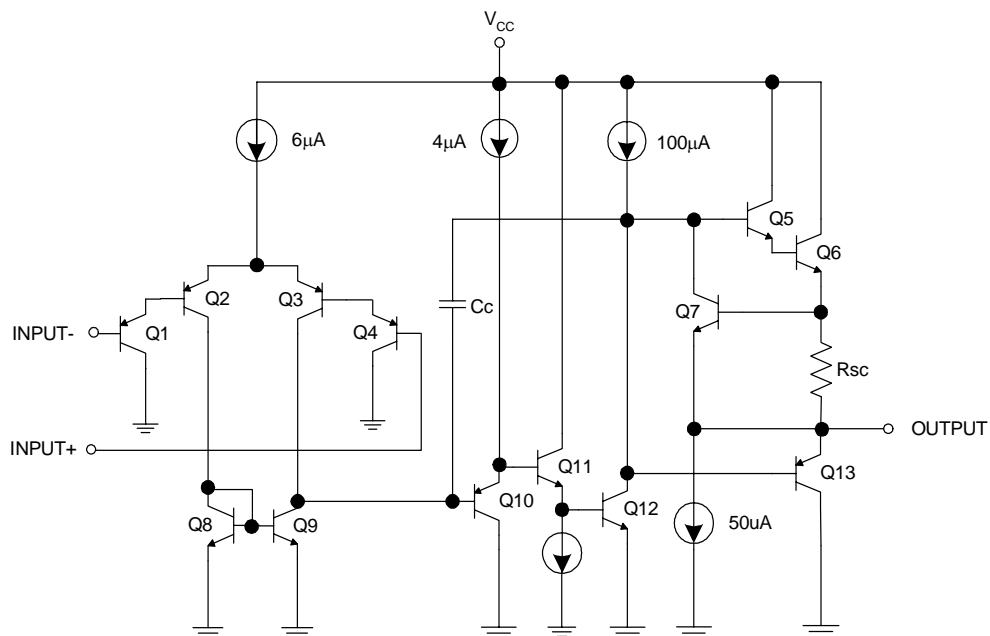


Figure 4. Op Amp Functional Block Diagram
(Each Amplifier)

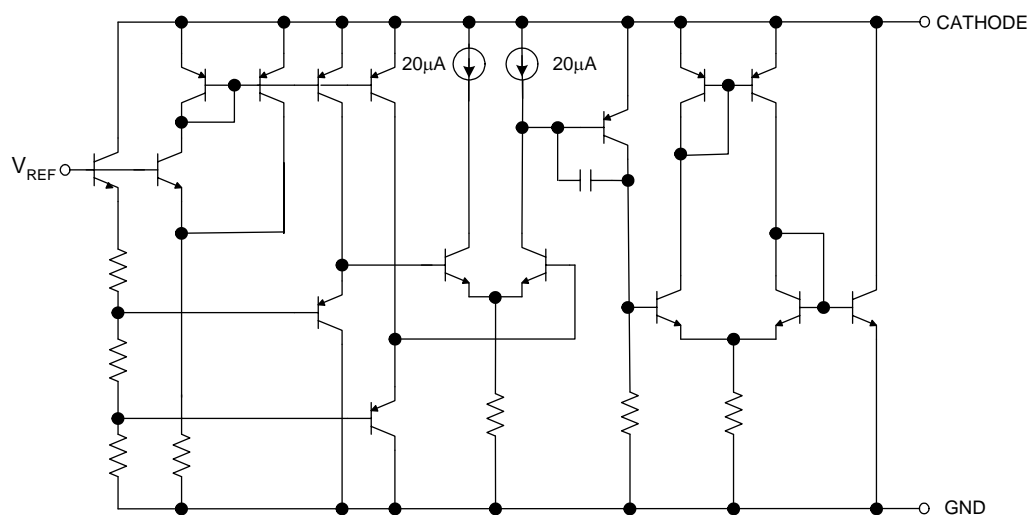


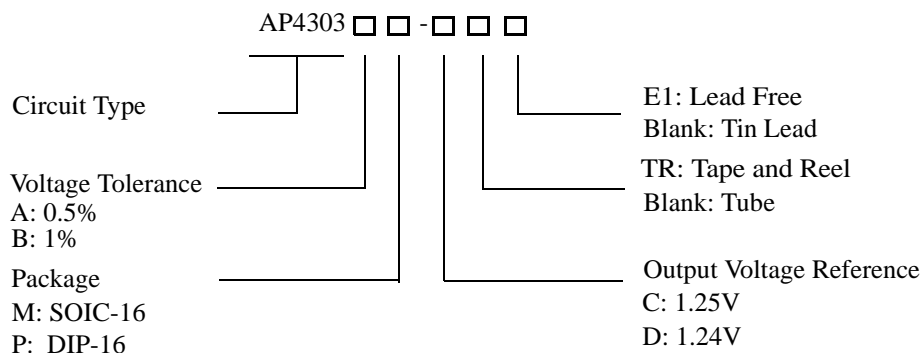
Figure 5. Voltage Reference Functional Block Diagram



QUAD OP AMP AND VOLTAGE REFERENCE

AP4303

Ordering Information



Package	Reference Voltage	Voltage Tolerance	Temperature Range	Part Number		Marking ID		Packing Type
				Tin Lead	Lead Free	Tin Lead	Lead Free	
DIP-16	1.25V	0.5%	-40 to 85°C	AP4303AP-C	AP4303AP-CE1	AP4303AP-C	AP4303AP-CE1	Tube
		1%		AP4303BP-C	AP4303BP-CE1	AP4303BP-C	AP4303BP-CE1	
	1.24V	0.5%		AP4303AP-D	AP4303AP-DE1	AP4303AP-D	AP4303AP-DE1	
		1%		AP4303BP-D	AP4303BP-DE1	AP4303BP-D	AP4303BP-DE1	
SOIC-16	1.25V	0.5%	-40 to 85°C	AP4303AM-C	AP4303AM-CE1	AP4303AM-C	AP4303AM-CE1	Tube
				AP4303AM-CTR	AP4303AM-CTRE1	AP4303AM-C	AP4303AM-CE1	Tape & Reel
		1%		AP4303BM-C	AP4303BM-CE1	AP4303BM-C	AP4303BM-CE1	Tube
				AP4303BM-CTR	AP4303BM-CTRE1	AP4303BM-C	AP4303BM-CE1	Tape & Reel
	1.24V	0.5%		AP4303AM-D	AP4303AM-DE1	AP4303AM-D	AP4303AM-DE1	Tube
				AP4303AM-DTR	AP4303AM-DTRE1	AP4303AM-D	AP4303AM-DE1	Tape & Reel
		1%		AP4303BM-D	AP4303BM-DE1	AP4303BM-D	AP4303BM-DE1	Tube
				AP4303BM-DTR	AP4303BM-DTRE1	AP4303BM-D	AP4303BM-DE1	Tape & Reel

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

**QUAD OP AMP AND VOLTAGE REFERENCE****AP4303****Absolute Maximum Ratings (Note 1)**

Parameter		Symbol	Value	Unit
Power Supply Voltage (V_{CC} to GND)		V_{CC}	20	V
Op Amp Input Voltage Range		V_{IN}	-0.3 to $V_{CC} + 0.3$	V
Op Amp Input Differentials Voltage		V_{ID}	20	V
Voltage Reference Cathode Current (Pin 9)		I_K	100	mA
Power Dissipation	DIP-16	P_D	1000	mW
	SOIC-16		1000	
Storage Temperature Range		T_{STG}	-65 to 150	°C
ESD Protection Voltage (Machine Model)			>200	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	18	V
Ambient Temperature	-40	85	°C



QUAD OP AMP AND VOLTAGE REFERENCE

AP4303

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°C ≤T _A ≤85°C			1.0	1.6	mA
	V _{CC} = 18V, no load, -40°C ≤T _A ≤85°C			1.2	2.4	
Voltage Reference Section						
Reference Voltage for AZ4303C	I _{KA} = 10mA T _A = 25°C	0.5% tolerance	1.244	1.250	1.256	V
		1% tolerance	1.237		1.263	
Reference Voltage for AZ4303D	I _{KA} = 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 _{KA} = 10mA, T _A = -40 to 85°C			5	17	mV
Minimum Cathode Current for Regulation	-			0.1	0.2	mA
Ratio of Change in VREF to that of Cathode Voltage	I _{KA} = 10mA	V _{REF} ~ 10V		1.0	2.7	mV/V
		10V ~ 18V		0.5	2.0	
Reference Current	I _{KA} = 10mA, R1 = 10K, R2 = ∞			0.7	4	μA
The Deviation of Reference Current over Temperature	V _{KA} = V _{REF} , I _{KA} = 10mA, T _A = -40°C to 85°C			0.4	1.2	μA
Off-State Cathode Current	V _{REF} = 0, V _{KA} = 18V			0.05	1.0	μA
Dynamic Impedance	I _{KA} = 1.0 to 80mA, f<1kHz			0.2	0.5	Ω
Op Amp Section (per OPA)						
(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 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



QUAD OP AMP AND VOLTAGE REFERENCE

AP4303

Electrical Characteristics (Continued)

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

Parameter		Conditions	Min	Typ	Max	Unit
Op Amp Section (per Op Amp) ($V_{CC} = 5V$, $V_O = 1.4V$, $T_A = 25^\circ C$, unless otherwise noted)						
Input Offset Voltage		$T_A = 25^\circ C$		0.5	3	mV
		$T_A = -40$ to $85^\circ C$			5	
Input Offset Voltage Temperature Drift		$T_A = -40$ to $85^\circ C$			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 $2V$, $C_L = 100pF$	0.3	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



Typical Performance Characteristics

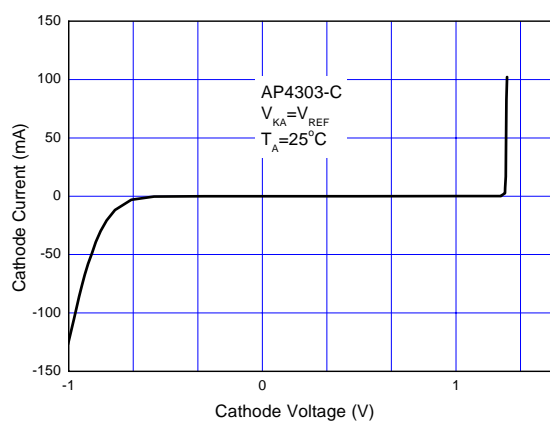


Figure 6. Cathode Current vs. Cathode Voltage

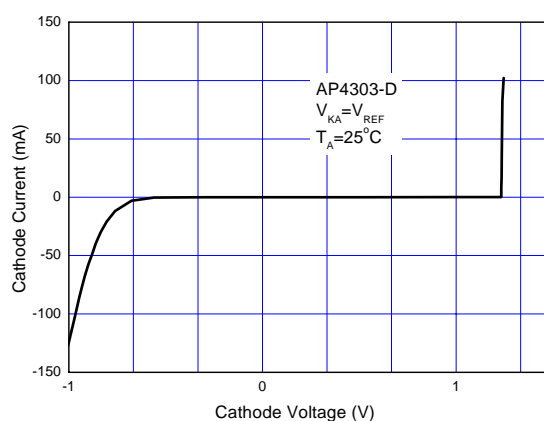


Figure 7. Cathode Current vs. Cathode Voltage

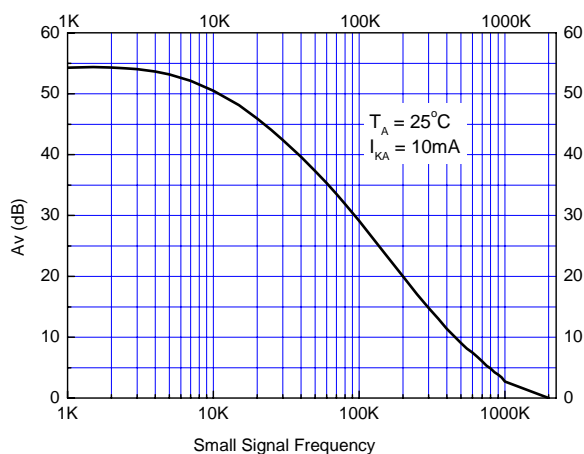


Figure 8. Voltage Reference Small Signal Voltage Gain vs. Frequency

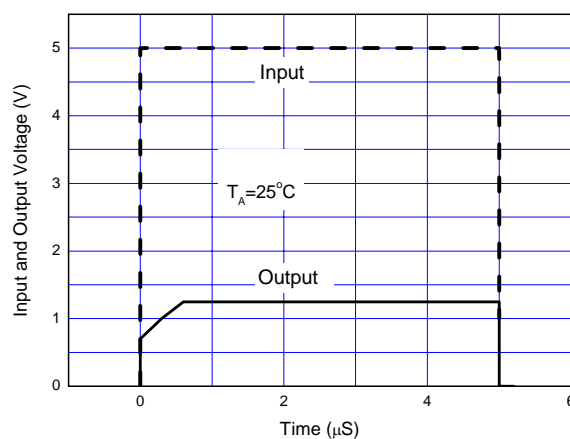


Figure 9. Pulse Response of V_{REF} with respect to V_{KA}

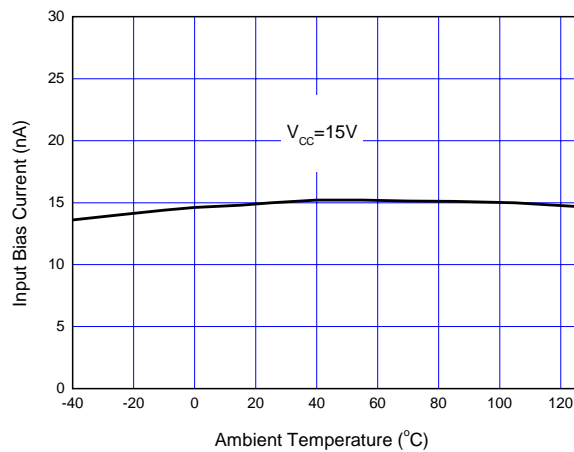
**QUAD OP AMP AND VOLTAGE REFERENCE****AP4303****Typical Performance Characteristics (Continued)**

Figure 10. Op Amp Input Current

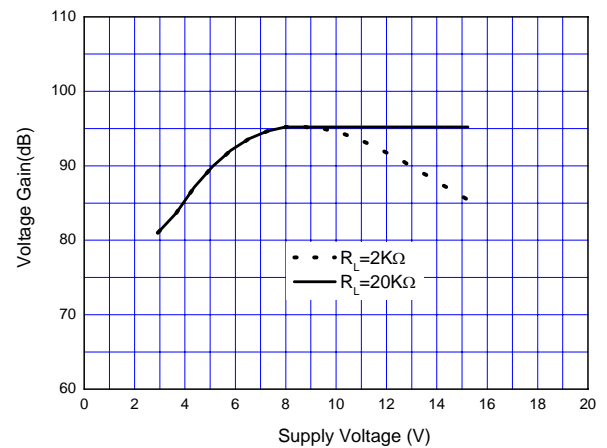


Figure 11. Op Amp Voltage Gain

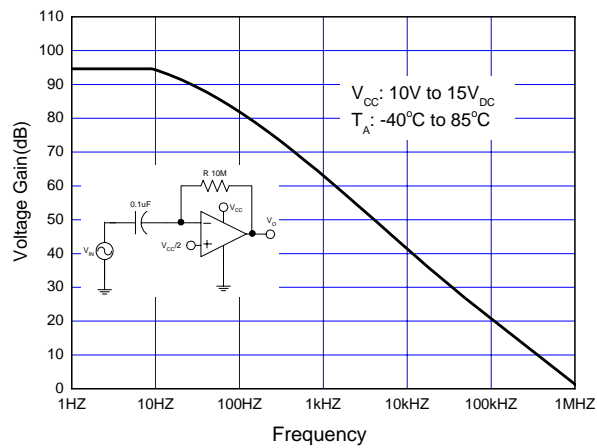
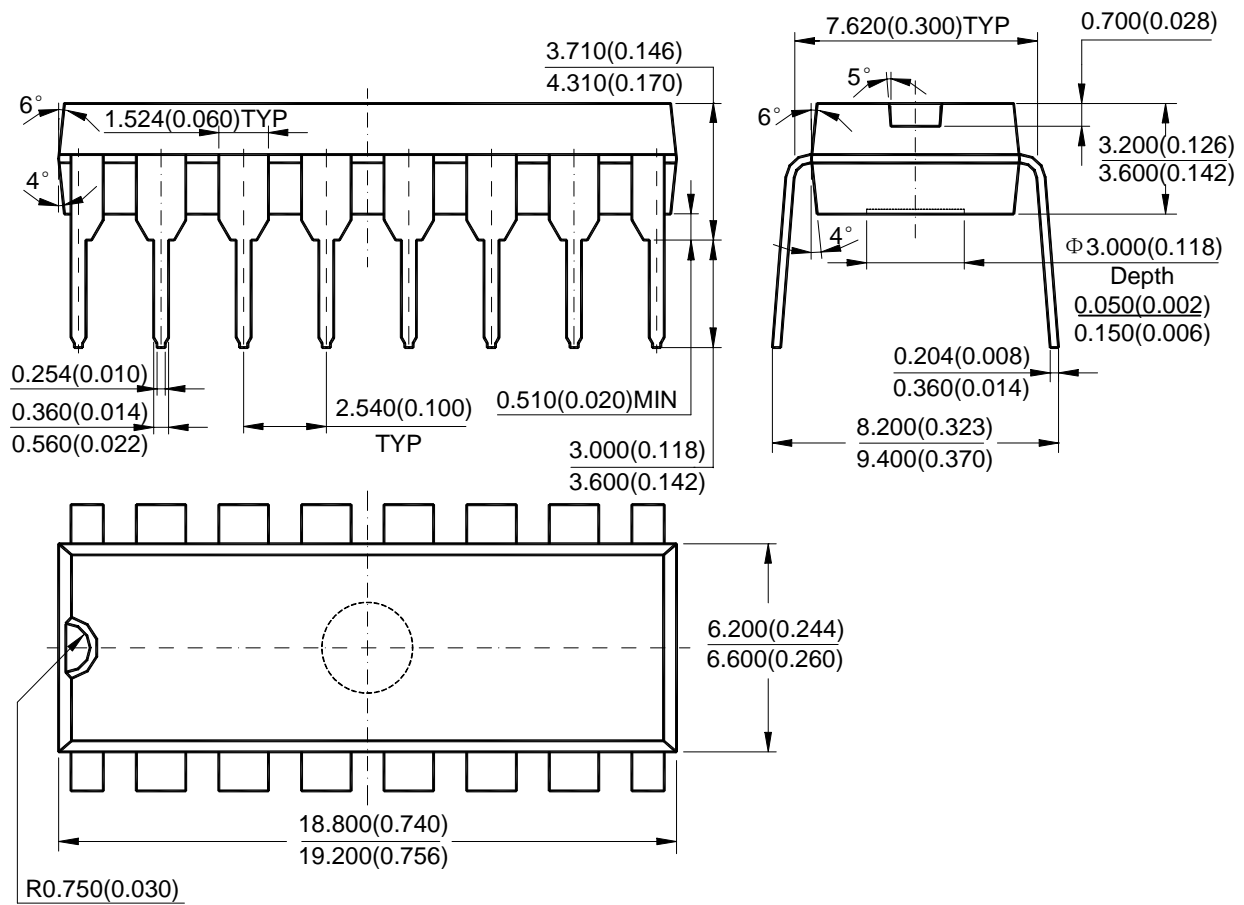


Figure 12. Open Loop Frequency Response

**QUAD OP AMP AND VOLTAGE REFERENCE****AP4303****Mechanical Dimensions****DIP-16****Unit: mm(inch)**



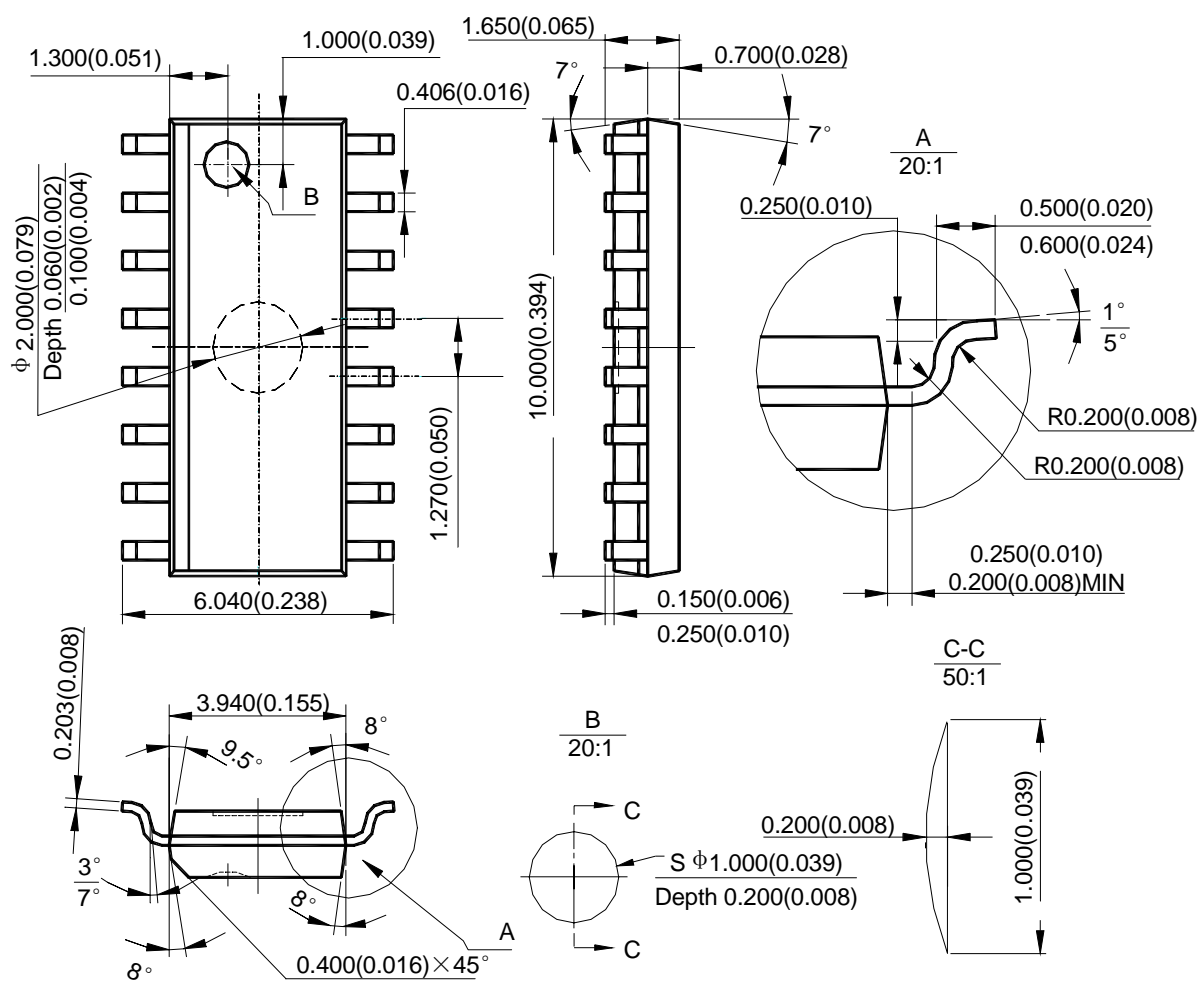
QUAD OP AMP AND VOLTAGE REFERENCE

AP4303

Mechanical Dimensions (Continued)

SOIC-16

Unit: mm(inch)





BCD Semiconductor Manufacturing Limited

<http://www.bcdsemi.com>

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

Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd.

800 Yi Shan Road, Shanghai 200233, PRC

Tel: +86-21-6485-1491, Fax: +86-21-5450-0008

Advanced Analog Circuits (Shanghai) Corporation

8F, B Zone, 900 Yi Shan Road, Shanghai 200233, PRC

Tel: +86-21-6495 9539, Fax: +86-21-6485 9673

BCD Semiconductor (Taiwan) Company Limited

Room 2210, 22nd Fl, 333, Keelung Road, Sec. 1, TaiPei (110), Taiwan

Tel: +886-2-2758 6828, Fax: +886-2-2758 6892

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.