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, 1.25Vfor 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 multifunction 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

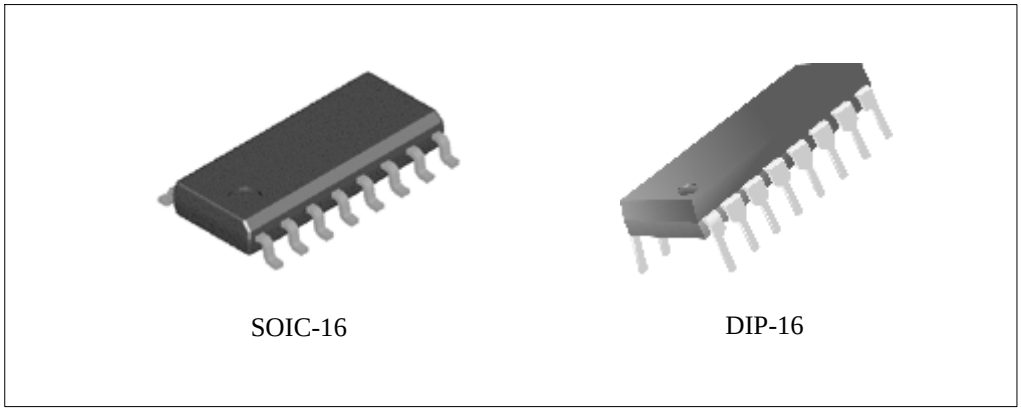
- Input Offset Voltage: 0.5mV
- Supply Current: 250μA per Op Amp at 5.0V Supply Voltage
- Unity Gain Bandwidth: 1MHz
- Output Voltage Swing: 0 to (V_{CC} - 1.5)V
- Power Supply Range: 3 to 18V

Voltage Reference

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

Applications

- Battery Charger
- Switching Power Supply

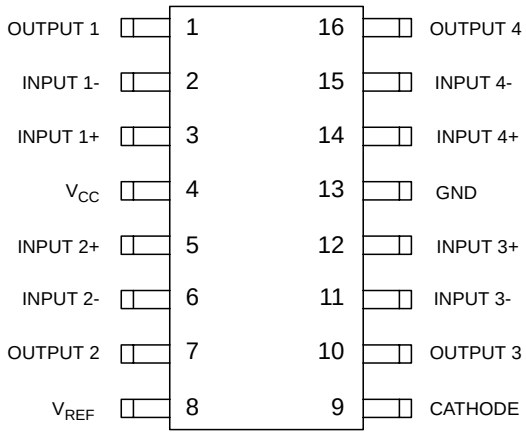


SOIC-16 DIP-16

Figure 1. Package Types of AP4303

Pin Configuration

M Package/P Package
(SOIC-16/DIP-16)



Top View

Figure 2. Pin configuration of AP4303

Functional Block Diagram

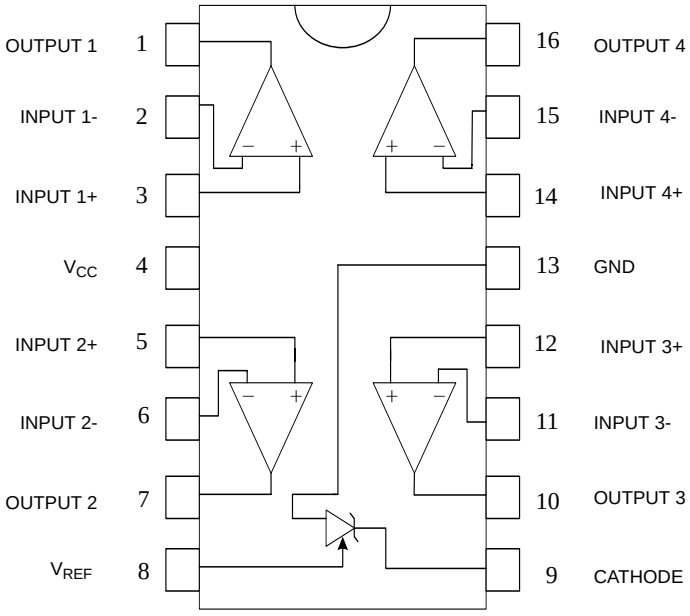


Figure 3. Functional Block Diagram of AP4303

Functional Block Diagram (Continued)

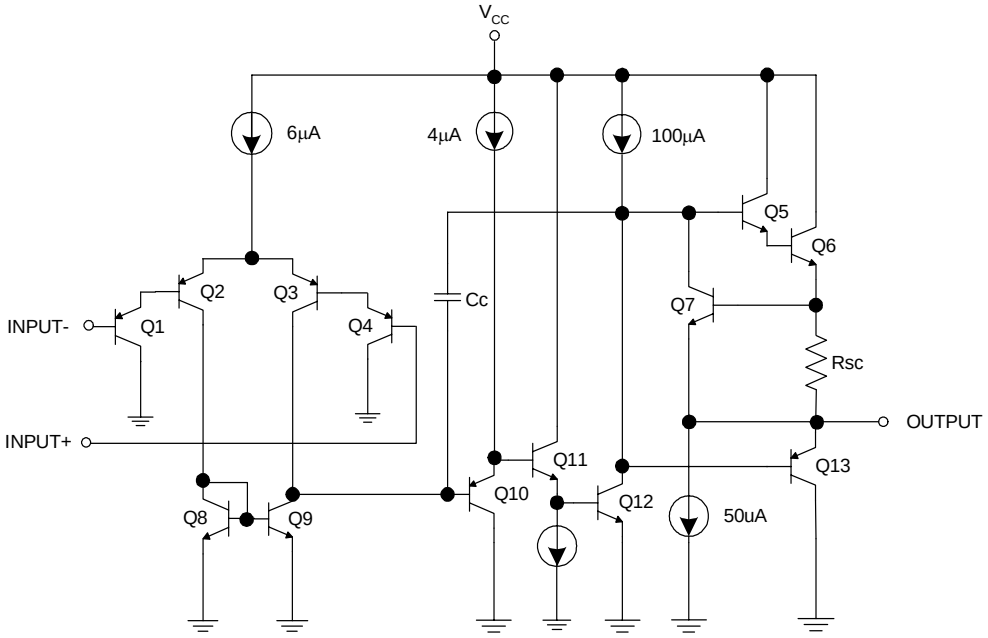


Figure 4. Op Amp Functional Block Diagram
(Each Amplifier)

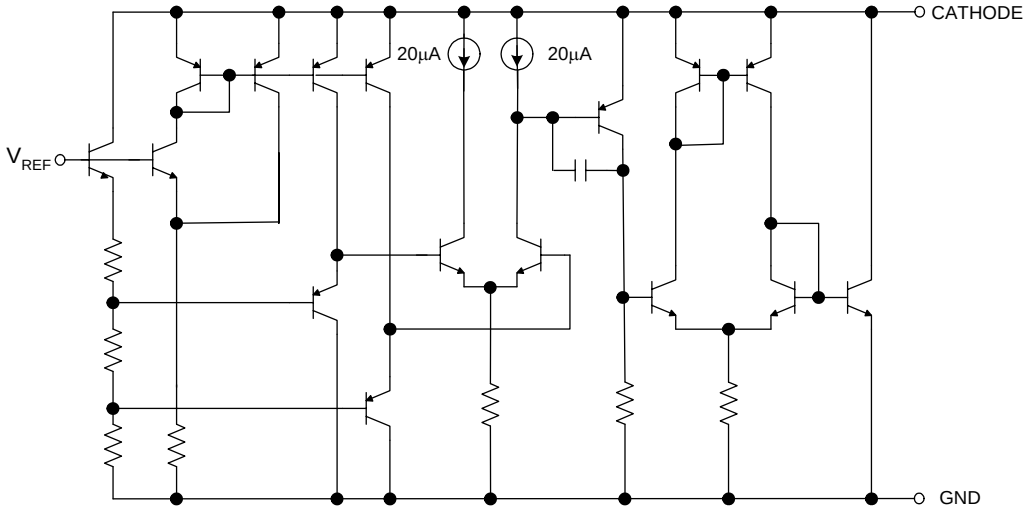
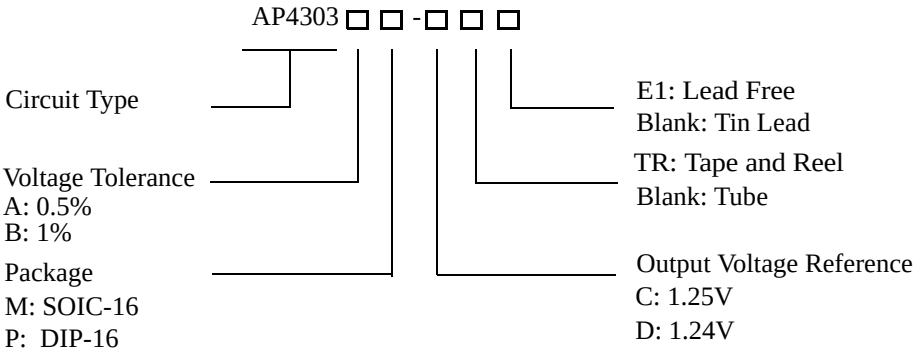


Figure 5. Voltage Reference Functional Block Diagram

Ordering Information



Package	Reference Voltage	Voltage Tolerance	Tempera-ture 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.

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

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			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

Electrical Characteristics (Continued)

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

Parameter		Conditions	Min	Typ	Max	Unit
Op Amp Section (per Op Amp) (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
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} = 18, R_L = 10kΩ, V_{ID} = 1V	16	16.5		V
Output Voltage Swing (Low)		V_{CC} = 18, 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	0.3	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

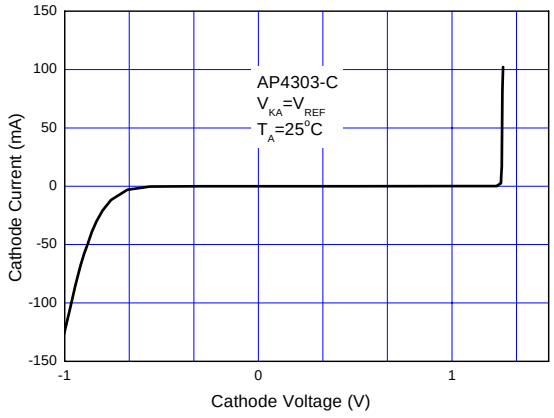


Figure 6. Cathode Current vs. Cathode Voltage

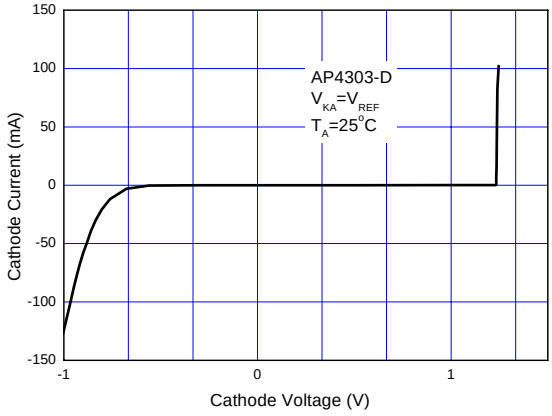


Figure 7.Cathode Current vs. Cathode Voltage

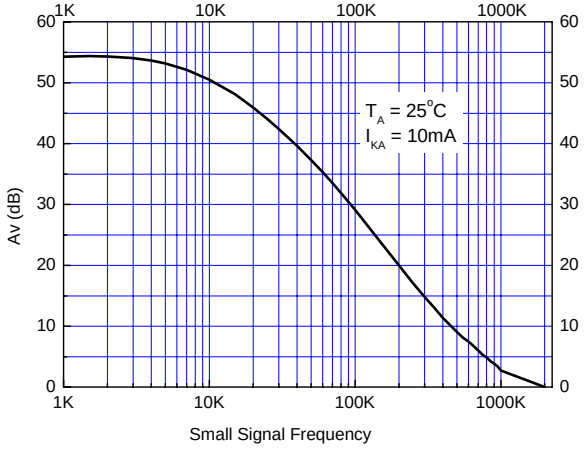


Figure 8. Voltage Reference Small Signal Voltage Gain vs. Frequency

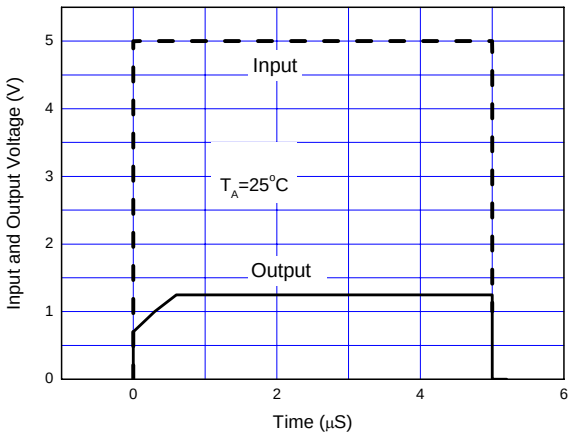


Figure 9. Pulse Response of V_{REF} with respect to V_{KA}

Typical Performance Characteristics (Continued)

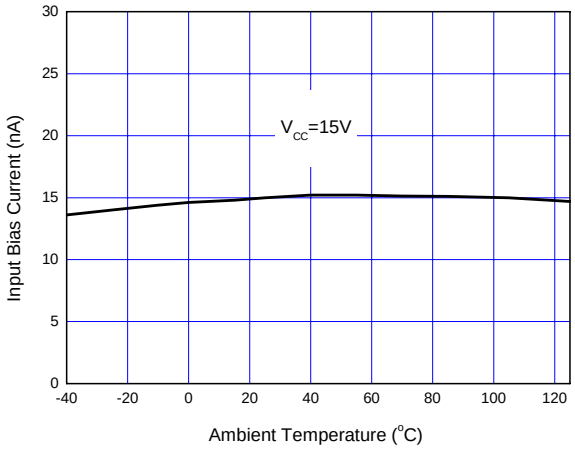


Figure10. Op Amp Input Current

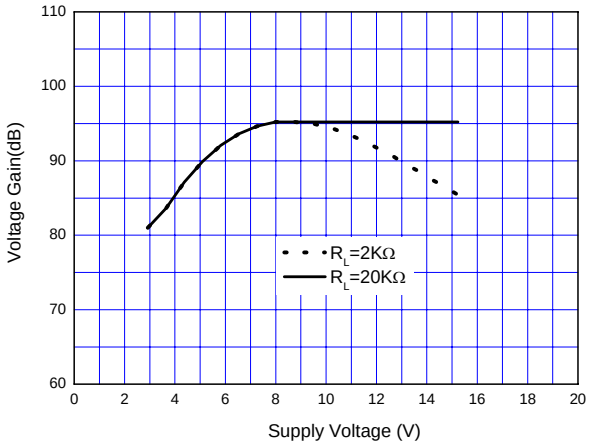


Figure 11. Op Amp Voltage Gain

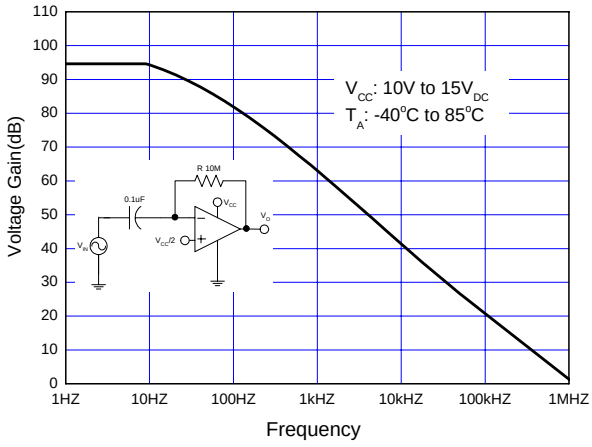
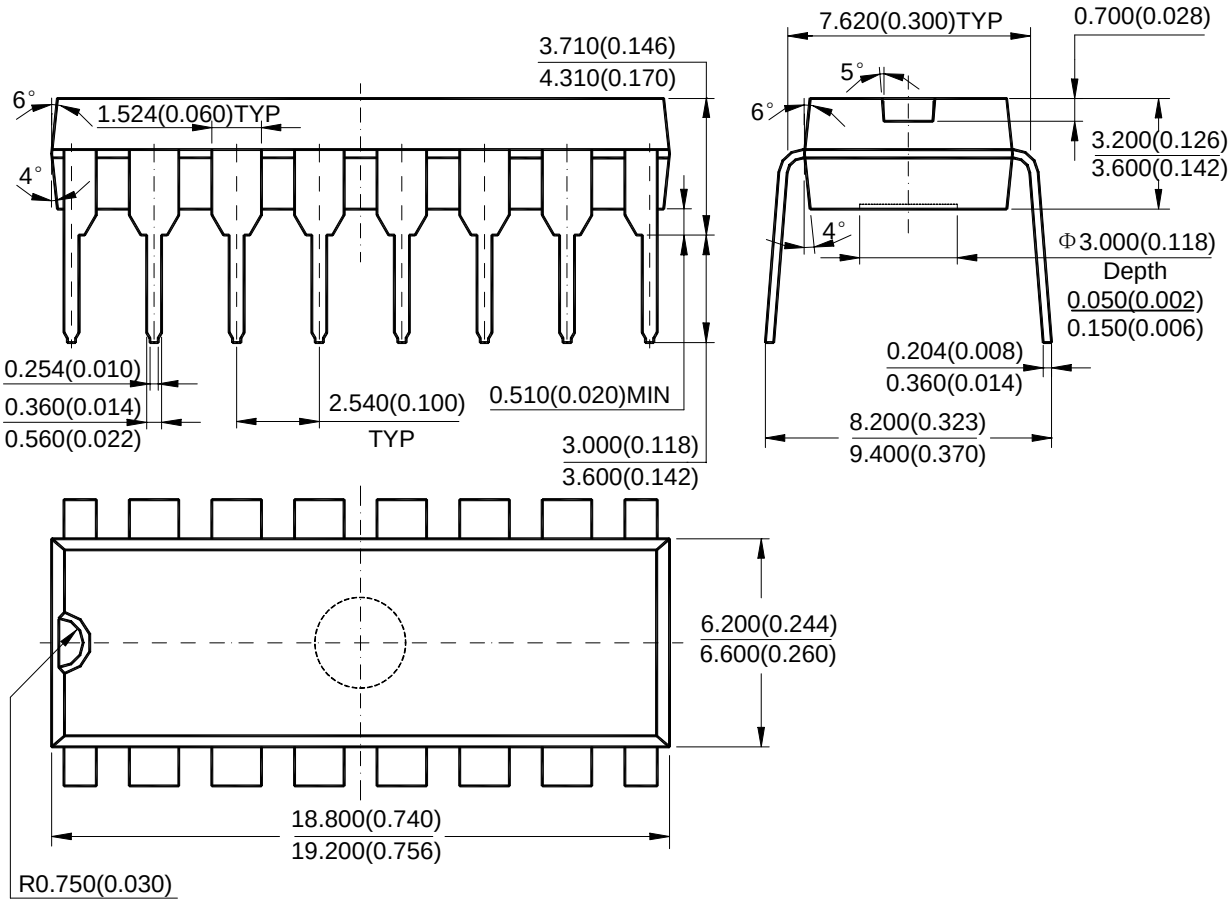


Figure 12. Open Loop Frequency Response

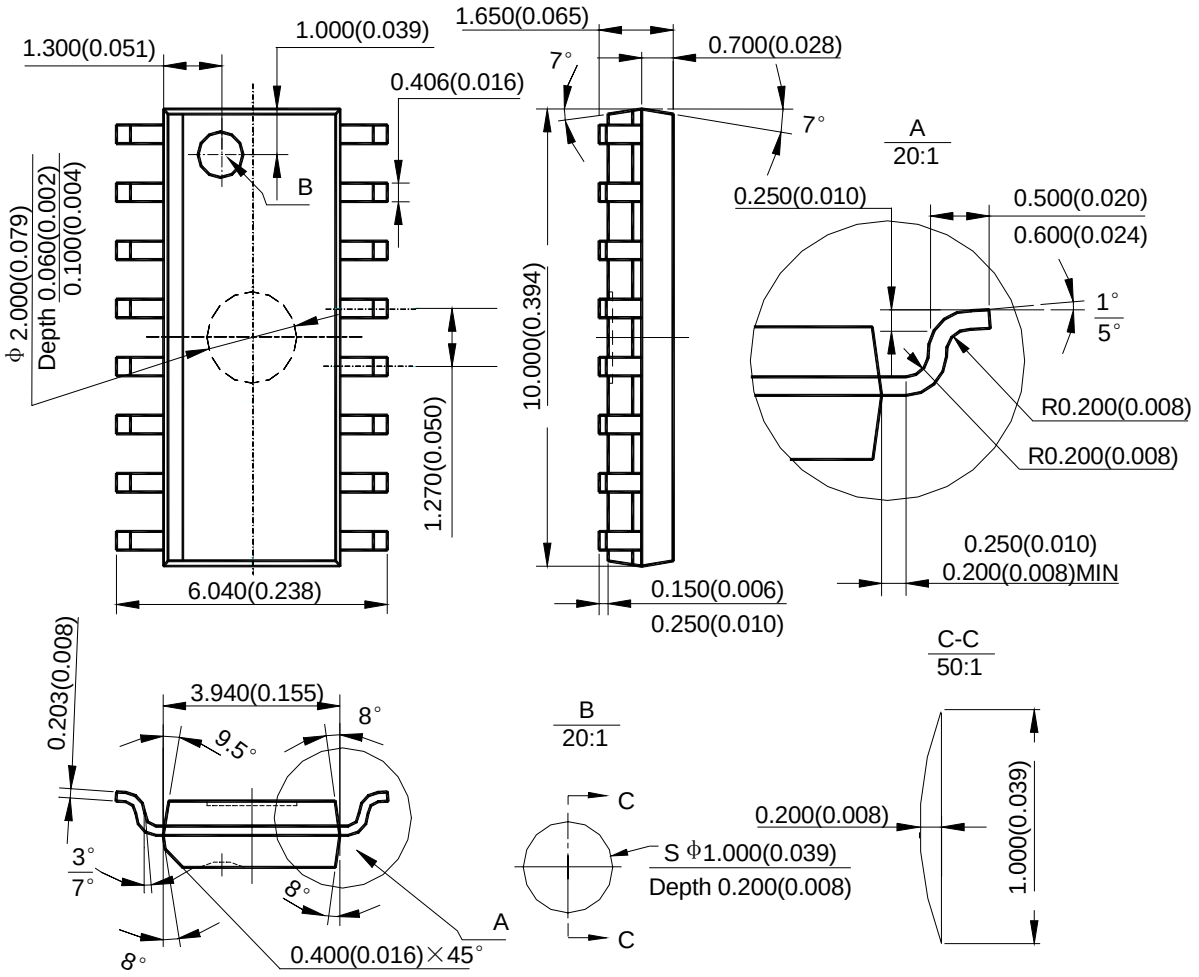
Mechanical Dimensions

DIP-16 **Unit: mm(inch)**



Mechanical Dimensions (Continued)

SOIC-16 **Unit: mm(inch)**



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