

## OP183/OP283

### FEATURES

**Single-Supply – 3 V to 36 V**  
**Wide Bandwidth – 5 MHz**  
**Low Offset Voltage – 1 mV**  
**High Slew Rate: 10 V/ $\mu$ s**  
**Low Noise: 10 nV/ $\sqrt{\text{Hz}}$**   
**Unity-Gain Stable**  
**Input and Output Range Includes GND**  
**No Phase Reversal**

### APPLICATIONS

**Multimedia**  
**Telecom**  
**ADC Buffers**  
**Wide Band Filters**  
**Microphone Preamplifiers**

### GENERAL DESCRIPTION

The OP183 is a single-supply, 5 MHz bandwidth amplifier with slew rates of 10 V/ $\mu$ s. The OP283 is a dual version. Both can operate from voltages as low as 3 V and up to 36 V. This combination of slew rate and bandwidth yields excellent single-supply ac performance, making these amplifiers ideally suited for telecom and multimedia audio applications.

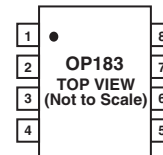
In addition to their ac characteristics, the OP183 family provides good dc performance with guaranteed 1 mV offset. Noise is a respectable 10 nV/ $\sqrt{\text{Hz}}$ . Supply current is only 1.2 mA per amplifier.

These amplifiers are well suited for single-supply applications that require moderate bandwidths even when used in high gain configurations. This makes them useful in filters and instrumentation. Their output drive capability and very wide full power bandwidth make them a good choice for multimedia headphone drivers or microphone input amplifiers.

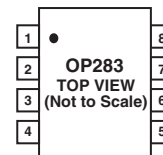
The OP183 and OP283 are available in SO-8 surface mount packages. They are specified over the extended industrial ( $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ) temperature range.

### PIN CONNECTIONS

8-Lead Narrow-Body SO  
(S Suffix)



8-Lead Narrow-Body SO  
(S Suffix)



### REV. C

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# OP183/OP283—SPECIFICATIONS

## ELECTRICAL CHARACTERISTICS (@ $V_S = 5.0\text{ V}$ , $T_A = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$V_{CM} = 2.5\text{ V}$ , $V_{OUT} = 2.5\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		0.025	1.0	mV
Input Bias Current	$I_B$	$V_{CM} = 2.5\text{ V}$ , $V_{OUT} = 2.5\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		350	600	nA
Input Offset Current	$I_{OS}$	$V_{CM} = 2.5\text{ V}$ , $V_{OUT} = 2.5\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		430	750	nA
Input Voltage Range				11	$\pm 50$	nA
Common-Mode Rejection Ratio	CMRR	$V_{CM} = 0$ to $3.5\text{ V}$ $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	0		3.5	V
Large Signal Voltage Gain	$A_{VO}$	$R_L = 2\text{ k}\Omega$ , $0.2 \leq V_O \leq 3.8\text{ V}$	70	104		dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$		100	4		$\mu\text{V}/^\circ\text{C}$
Bias Current Drift	$\Delta I_B/\Delta T$			-1.6		$\text{nA}/^\circ\text{C}$
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage High	$V_{OH}$	$R_L = 2\text{ k}\Omega$ to GND	4.0	4.22		V
Output Voltage Low	$V_{OL}$	$R_L = 2\text{ k}\Omega$ to GND		50	75	mV
Short Circuit Limit	$I_{SC}$	Source		25		mA
		Sink		30		mA
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	$V_S = 4\text{ V}$ to $6\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	70	104		dB
Supply Current/Amplifier	$I_{SY}$	$V_O = 2.5\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		1.2	1.5	mA
Supply Voltage Range	$V_S$		3		$\pm 18$	V
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	$R_L = 2\text{ k}\Omega$	5	10		$\text{V}/\mu\text{s}$
Full-Power Bandwidth	BW <sub>p</sub>	1% Distortion		>50		kHz
Settling Time	$t_s$	To 0.01%		1.5		$\mu\text{s}$
Gain Bandwidth Product	GBP			5		MHz
Phase Margin	$\phi_m$			46		Degrees
<b>NOISE PERFORMANCE</b>						
Voltage Noise	$e_n$ p-p	0.1 Hz to 10 Hz		2		$\mu\text{V p-p}$
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$ , $V_{CM} = 2.5\text{ V}$		10		$\text{nV}/\sqrt{\text{Hz}}$
Current Noise Density	$i_n$			0.4		$\text{pA}/\sqrt{\text{Hz}}$

## ELECTRICAL CHARACTERISTICS (@ $V_S = 3.0\text{ V}$ , $T_A = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$V_{CM} = 1.5\text{ V}$ , $V_{OUT} = 1.5\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		0.3	1.0	mV
Input Bias Current	$I_B$	$V_{CM} = 1.5\text{ V}$ , $V_{OUT} = 1.5\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		350	600	nA
Input Offset Current	$I_{OS}$	$V_{CM} = 1.5\text{ V}$ , $V_{OUT} = 1.5\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		430	750	nA
Input Voltage Range				11	$\pm 50$	nA
Common-Mode Rejection Ratio	CMRR	$V_{CM} = 0\text{ V}$ to $1.5\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	0		1.5	V
Large Signal Voltage Gain	$A_{VO}$	$R_L = 2\text{ k}\Omega$ , $0.2 \leq V_O \leq 1.8\text{ V}$	70	103		dB
			100	260		$\text{V}/\text{mV}$
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage High	$V_{OH}$	$R_L = 2\text{ k}\Omega$ to GND	2.0	2.25		V
Output Voltage Low	$V_{OL}$	$R_L = 2\text{ k}\Omega$ to GND		90	125	mV
Short Circuit Limit	$I_{SC}$	Source		25		mA
		Sink		30		mA
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	$V_S = 2.5\text{ V}$ to $3.5\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	60	113		dB
Supply Current/Amplifier	$I_{SY}$	$-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$ , $V_O = 1.5\text{ V}$		1.2	1.5	mA
<b>DYNAMIC PERFORMANCE</b>						
Gain Bandwidth Product	GBP			5		MHz
<b>NOISE PERFORMANCE</b>						
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$ , $V_{CM} = 1.5\text{ V}$		10		$\text{nV}/\sqrt{\text{Hz}}$

**ELECTRICAL CHARACTERISTICS** (@  $V_S = \pm 15.0\text{ V}$ ,  $T_A = 25^\circ\text{C}$  unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>INPUT CHARACTERISTICS</b>						
Offset Voltage	$V_{OS}$	$-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		0.01	1.0	mV
Input Bias Current	$I_B$	$-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		300	1.25	mV
Input Offset Current	$I_{OS}$	$-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		400	600	nA
Input Voltage Range		$-40 \leq T_A \leq +85^\circ\text{C}$	-15		$\pm 50$	nA
Common-Mode Rejection Ratio	CMRR	$V_{CM} = -15\text{ V to } +13.5\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$			+13.5	V
Large Signal Voltage Gain	$A_{VO}$	$R_L = 2\text{ k}\Omega$	70	86		dB
Offset Voltage Drift	$\Delta V_{OS}/\Delta T$		100	1000		V/mV
Bias Current Drift	$\Delta I_B/\Delta T$			3		$\mu\text{V}/^\circ\text{C}$
Long Term Offset Voltage	$V_{OS}$	Note 1		-1.6		$\text{nA}/^\circ\text{C}$
					1.5	mV
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage High	$V_{OH}$	$R_L = 2\text{ k}\Omega$ to GND, $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	13.9	14.1		V
Output Voltage Low	$V_{OL}$	$R_L = 2\text{ k}\Omega$ to GND, $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		-14.05	-13.9	V
Short-Circuit Limit	$I_{SC}$	Source		30		mA
		Sink		50		mA
Open -Loop Output Impedance	$Z_{OUT}$	$f = 1\text{ MHz}$ , $A_V = +1$		15		$\Omega$
<b>POWER SUPPLY</b>						
Power Supply Rejection Ratio	PSRR	$V_S = \pm 2.5\text{ V to } \pm 18\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$	70	112		dB
Supply Current/Amplifier	$I_{SY}$	$V_S = \pm 18\text{ V}$ , $V_O = 0\text{ V}$ , $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$		1.2	1.75	mA
Supply Voltage Range	$V_S$		3		$\pm 18$	V
<b>DYNAMIC PERFORMANCE</b>						
Slew Rate	SR	$R_L = 2\text{ k}\Omega$	10	15		V/ $\mu\text{s}$
Full-Power Bandwidth	$BW_p$	1% Distortion		50		kHz
Settling Time	$t_s$	To 0.01%		1.5		$\mu\text{s}$
Gain Bandwidth Product	GBP			5		MHz
Phase Margin	$\phi_m$			56		Degrees
<b>NOISE PERFORMANCE</b>						
Voltage Noise	$e_n$ p-p	0.1 Hz to 10 Hz		2		$\mu\text{V p-p}$
Voltage Noise Density	$e_n$	$f = 1\text{ kHz}$		10		$\text{nV}/\sqrt{\text{Hz}}$
Current Noise Density	$i_n$			0.4		$\text{pA}/\sqrt{\text{Hz}}$

NOTES

<sup>1</sup>Long term offset voltage is guaranteed by a 1000 hour life test performed on three independent lots at 125°C, with an LTPD of 1.3.

Specifications subject to change without notice.

# OP183/OP283

## ABSOLUTE MAXIMUM RATINGS<sup>1</sup>

Supply Voltage	±18 V
Input Voltage	±18 V
Differential Input Voltage <sup>2</sup>	±7 V
Output Short-Circuit Duration to GND	Indefinite
Storage Temperature Range	
S Package	-65°C to +150°C
Operating Temperature Range	
OP183/OP283G	-40°C to +85°C
Junction Temperature Range	
S Package	-65°C to +150°C
Lead Temperature Range (Soldering 60 sec)	300°C

Package Type	$\theta_{JA}$ <sup>3</sup>	$\theta_{JC}$	Units
8-Lead SOIC (S)	158	43	°C/W

## NOTES

<sup>1</sup>Absolute maximum ratings apply to packaged parts, unless otherwise noted.

<sup>2</sup>For supply voltages less than ±7 V, the absolute maximum input voltage is equal to the supply voltage. Maximum input current should not exceed 2 mA.

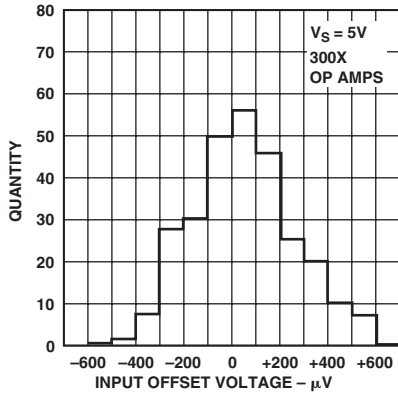
<sup>3</sup> $\theta_{JA}$  is specified for the worst case conditions, i.e.,  $\theta_{JA}$  is specified for device soldered in circuit board for SOIC packages.

## ORDERING GUIDE

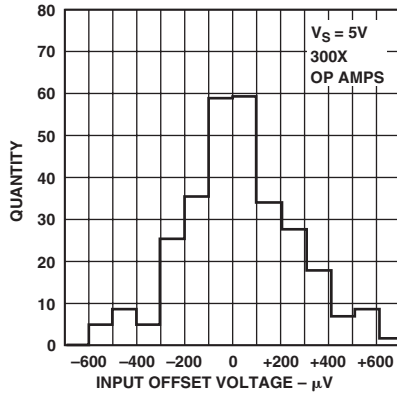
Model	Temperature Range	Package Description	Package Option
OP183GS	-40°C to +85°C	8-Lead SOIC	SO-8
OP283GS*	-40°C to +85°C	8-Lead SOIC	SO-8

\*Not for new design; obsolete April 2002.

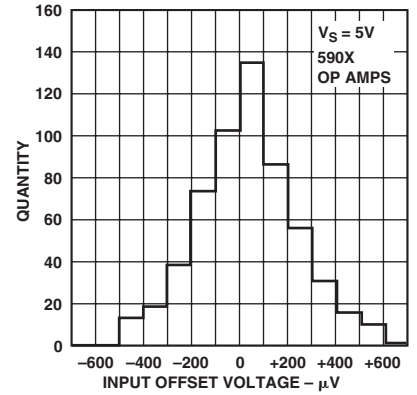
# Typical Performance Characteristics—OP183/OP283



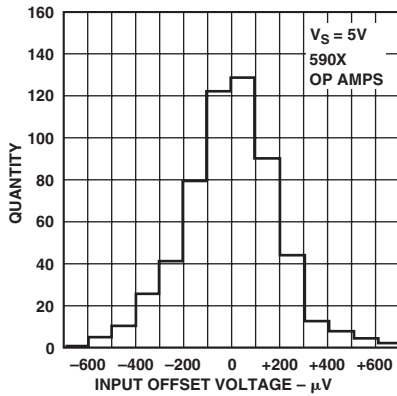
TPC 1. OP183 Input Offset Voltage Distribution @ 5 V



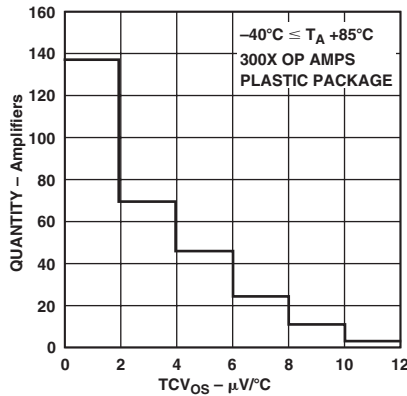
TPC 2. OP183 Input Offset Voltage Distribution @ ±15 V



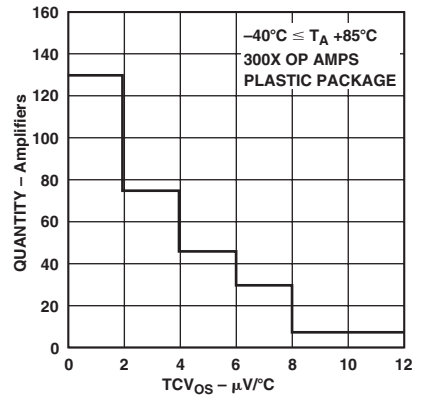
TPC 3. OP283 Input Offset Voltage Distribution @ 5 V



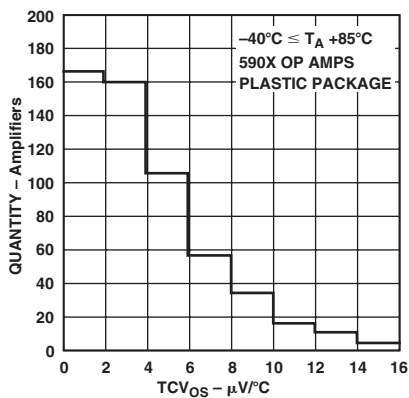
TPC 4. OP283 Input Offset Voltage Distribution @ ±15 V



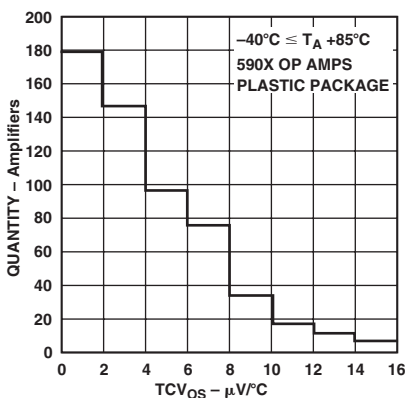
TPC 5. OP183 Input Offset Voltage Drift ( $TCV_{OS}$ ) Distribution @ 5 V



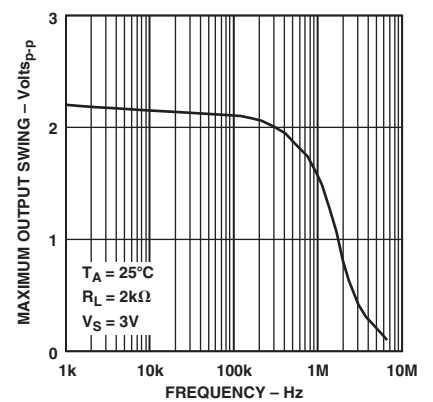
TPC 6. OP183 Input Offset Voltage Drift ( $TCV_{OS}$ ) Distribution @ ±15 V



TPC 7. OP283 Input Offset Voltage Drift ( $TCV_{OS}$ ) Distribution @ 5 V

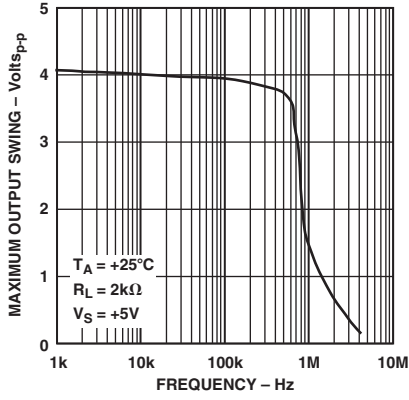


TPC 8. OP283 Input Offset Voltage Drift ( $TCV_{OS}$ ) Distribution @ ±15 V

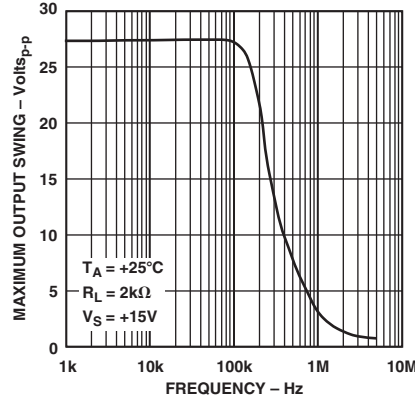


TPC 9. OP183/OP283 Maximum Output Swing vs. Frequency @ 3 V

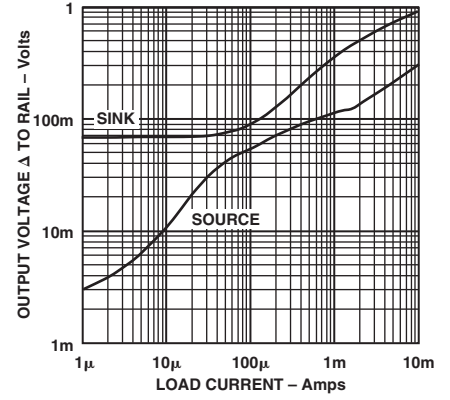
# OP183/OP283



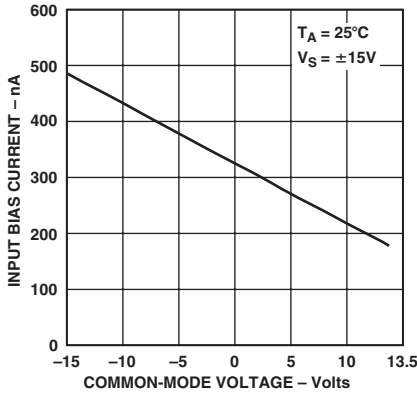
TPC 10. OP183/OP283 Maximum Output Swing vs. Frequency @ 5 V



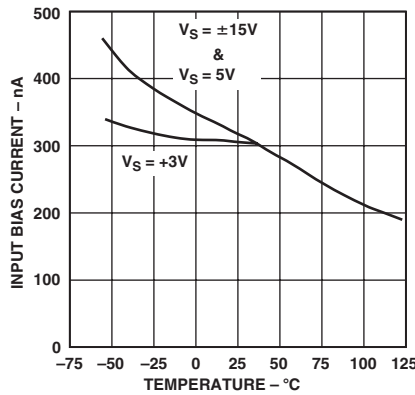
TPC 11. OP183/OP283 Maximum Output Swing vs. Frequency @ ±15 V



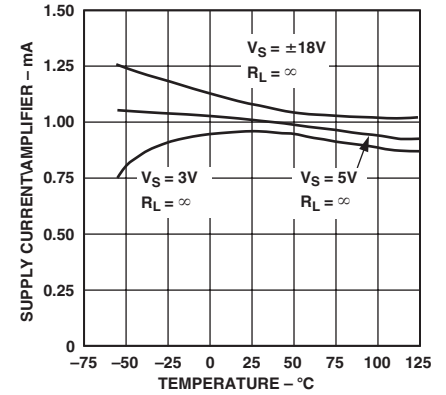
TPC 12. Output Voltage vs. Sink & Source Current



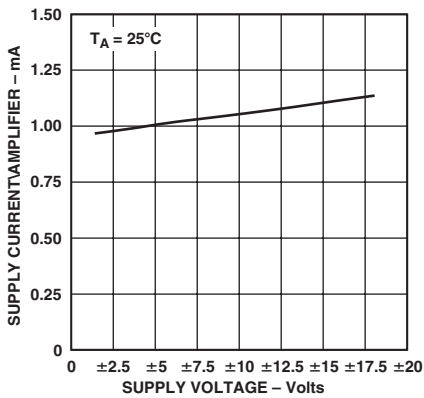
TPC 13. Input Bias Current vs. Common-Mode Voltage



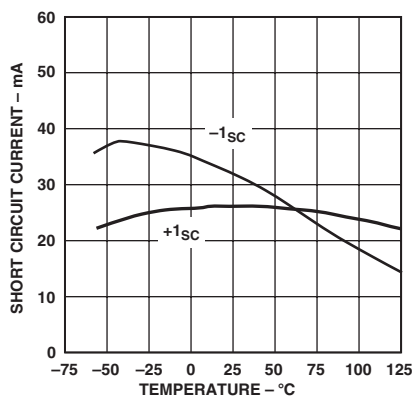
TPC 14. Input Bias Current vs. Temperature



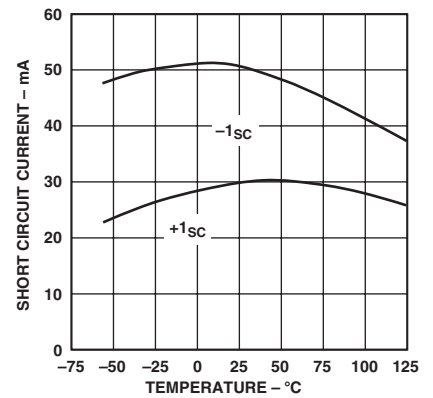
TPC 15. Supply Current per Amplifier vs. Temperature



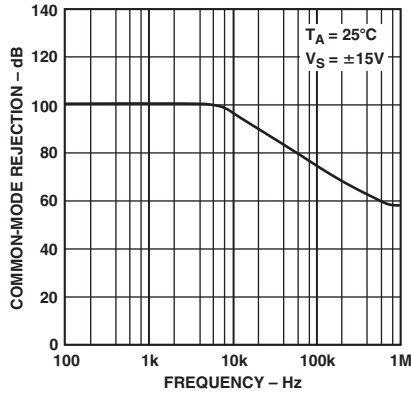
TPC 16. Supply Current per Amplifier vs. Supply Voltage



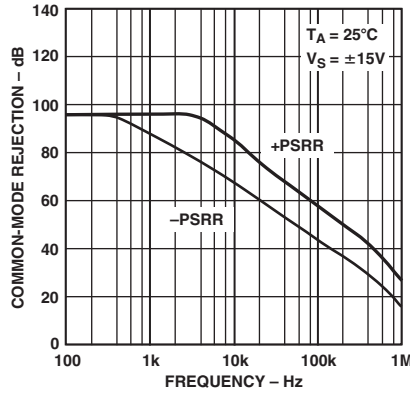
TPC 17. Short-Circuit Current vs. Temperature @ 5 V



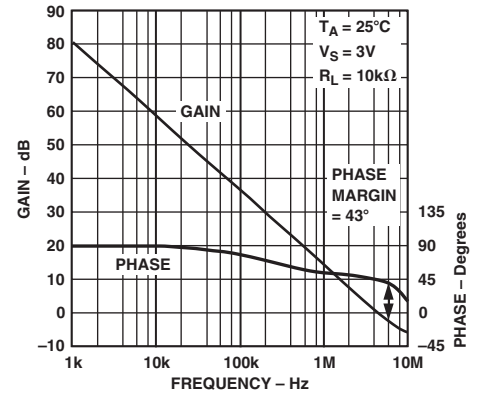
TPC 18. Short-Circuit Current vs. Temperature @ ±15 V



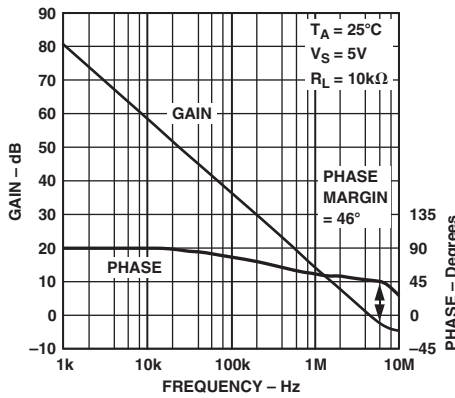
TPC 19. Common-Mode Rejection vs. Frequency



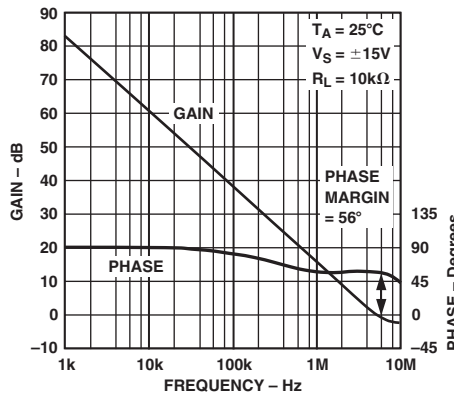
TPC 20. Power Supply Rejection vs. Frequency



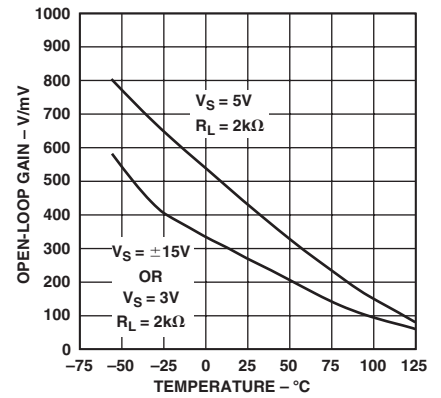
TPC 21. Open-Loop Gain and Phase vs. Frequency @ 3 V



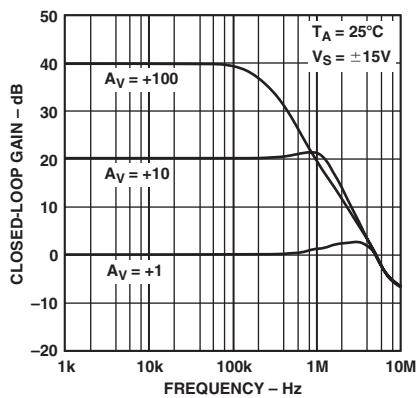
TPC 22. Open-Loop Gain and Phase vs. Frequency @ 5 V



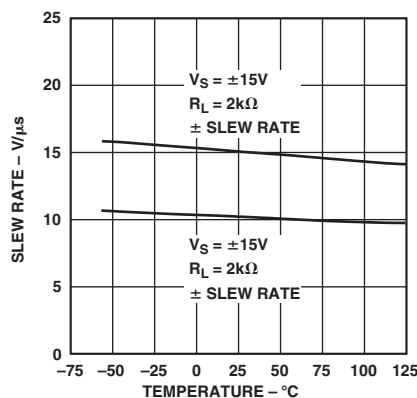
TPC 23. Open-Loop Gain and Phase vs. Frequency @ ±15 V



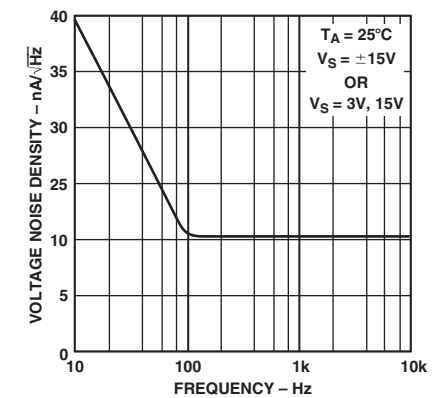
TPC 24. Open-Loop Gain vs. Temperature



TPC 25. Closed-Loop Gain vs. Frequency

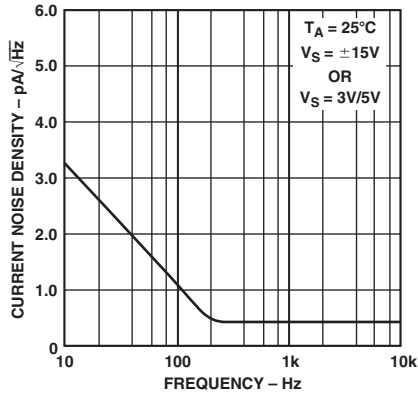


TPC 26. Slew Rate vs. Temperature

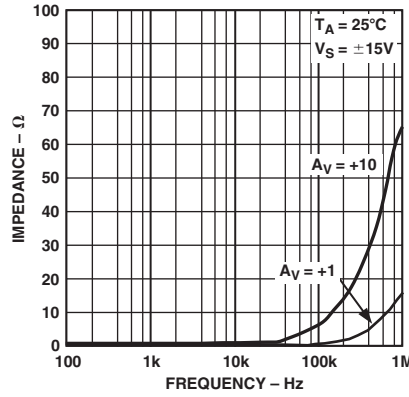


TPC 27. Voltage Noise Density vs. Frequency

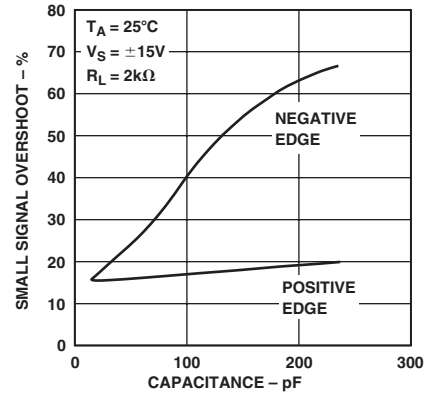
# OP183/OP283



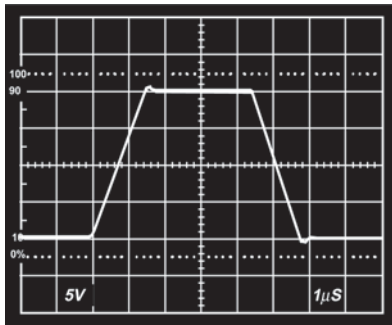
TPC 28. Current Noise Density vs. Frequency



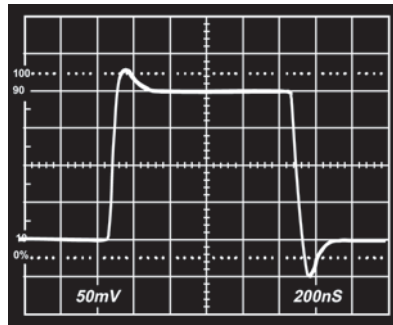
TPC 29. Closed-Loop Output Impedance vs. Frequency



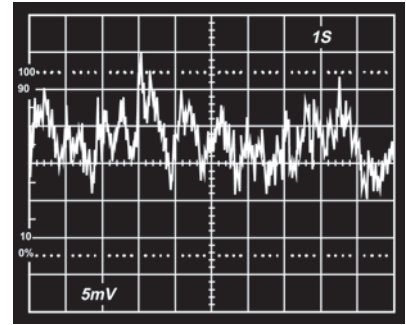
TPC 30. Small Signal Overshoot vs. Load Capacitance



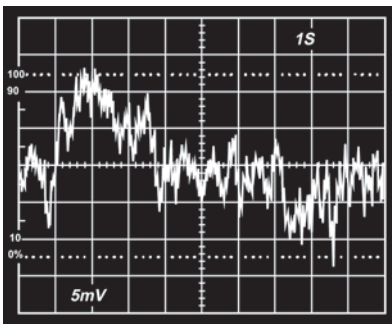
TPC 31. Large Signal Performance @ ±15 V



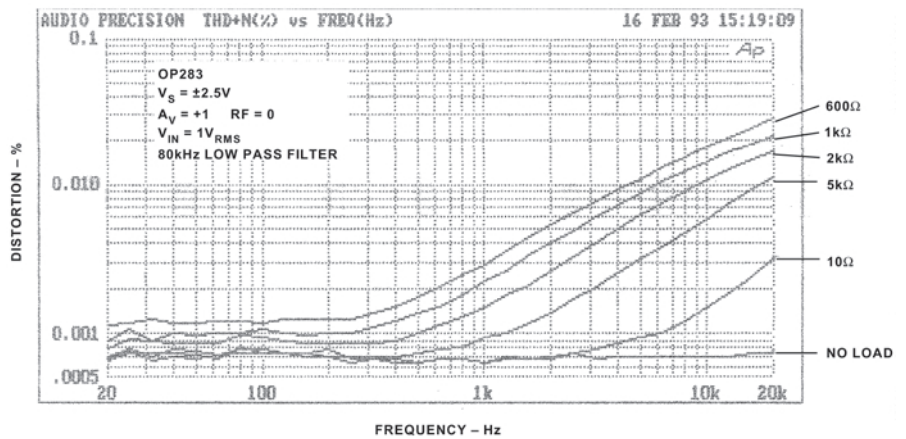
TPC 32. Small Signal Performance @ ±15 V



TPC 33. 0.1 Hz to 10 Hz Noise @ ±2.5 V



TPC 34. 0.1 Hz to 10 Hz Noise @ ±15 V



TPC 35. THD + Noise vs. Frequency for Various Loads



## APPLICATIONS

### OP183 Offset Adjust

Figure 1 shows how the offset voltage of the OP183 can be adjusted by connecting a potentiometer between Pins 1 and 5, and connecting the wiper to  $V_{EE}$ . The recommended value for the potentiometer is 10 k $\Omega$ . This will give an adjustment range of approximately  $\pm 1$  mV. If larger adjustment span is desired, a 50 k $\Omega$  potentiometer will yield a range of  $\pm 2.5$  mV.

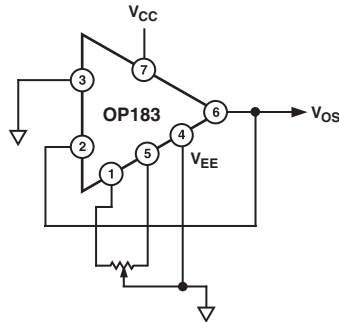


Figure 1. OP183 Offset Adjust

### Phase Reversal

The OP183 family is protected against phase reversal as long as both of the inputs are within the range of the positive supply and the negative supply minus 0.6 volts. If there is a possibility of either input going beyond these limits, however, the inputs should be protected with a series resistor to limit input current to 2 mA.

### Direct Access Arrangement

The OP183/OP283 can be used in a single supply Direct Access Arrangement (DAA) as shown in Figure 2. This figure shows a portion of a typical DAA capable of operating from a single 5 V supply; with minor modifications it should also work on 3 V supplies. Amplifiers A2 and A3 are configured so that the transmit signal TXA is inverted by A2 and not inverted by A3. This

arrangement drives the transformer differentially so that the drive to the transformer is effectively doubled over a single amplifier arrangement. This application takes advantage of the OP183/283's ability to drive capacitive loads and to save power in single-supply applications.

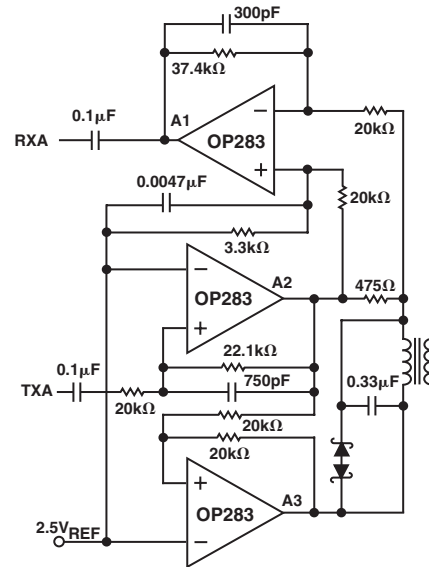


Figure 2. Direct Access Arrangement

### 5 V Only Stereo DAC for Multimedia

The low noise and single supply capability of the OP283 are ideally suited for stereo DAC audio reproduction or sound synthesis applications such as multimedia systems. Figure 3 shows an 18-bit stereo DAC output setup that is powered from a single 5 V supply. The low noise preserves the 18-bit dynamic range of the AD1868. For DACs that operate on dual supplies, the OP283 can also be powered from the same supplies.

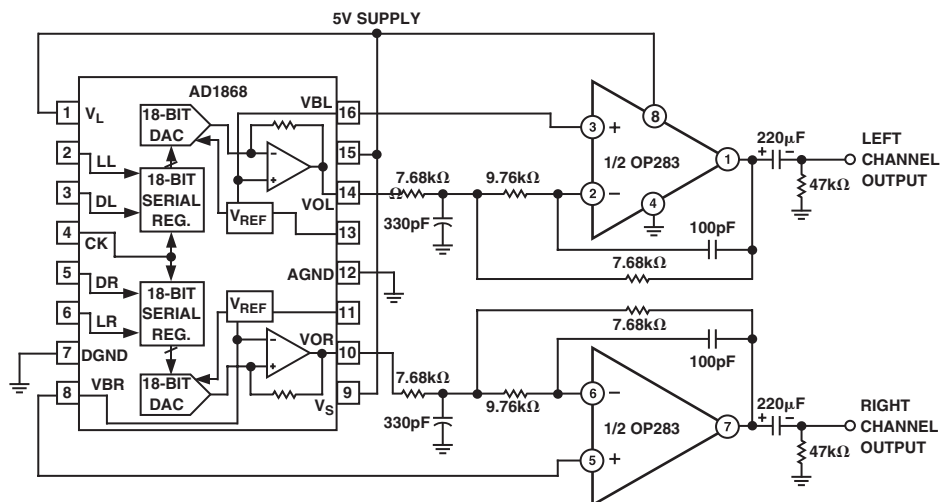


Figure 3. 5 Volt Only 18-Bit Stereo DAC

# OP183/OP283

## Low Voltage Headphone Amplifiers

Figure 4 shows a stereo headphone output amplifier for the AD1849 16-bit SoundPort® Stereo Codec device. The pseudo-reference voltage is derived from the common-mode voltage generated internally by the AD1849, thus providing a convenient bias for the headphone output amplifiers.

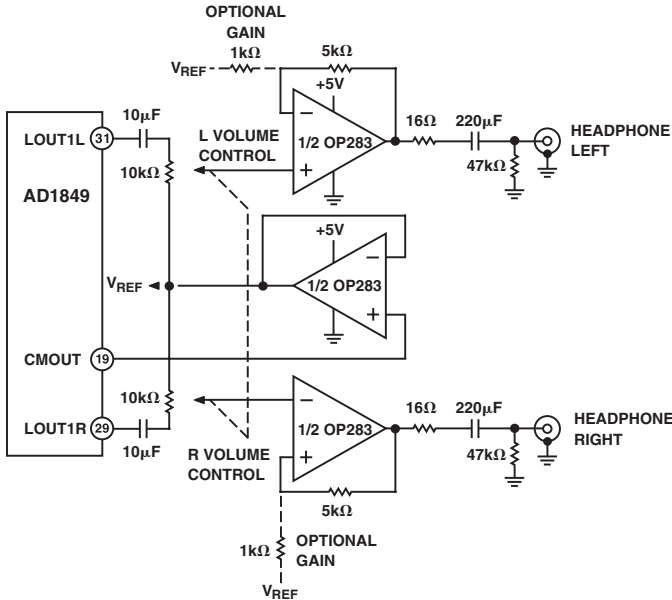


Figure 4. Headphone Output Amplifier for Multimedia Sound Codec

SoundPort is a registered trademark of Analog Devices, Inc.

## Low Noise Microphone Amplifier for Multimedia

The OP183 family is ideally suited as a low noise microphone preamp for low voltage audio applications. Figure 5 shows a gain of 100 stereo preamp for the AD1849 16-bit SoundPort Stereo Codec chip. The common-mode output buffer serves as a “phantom power” driver for the microphones.

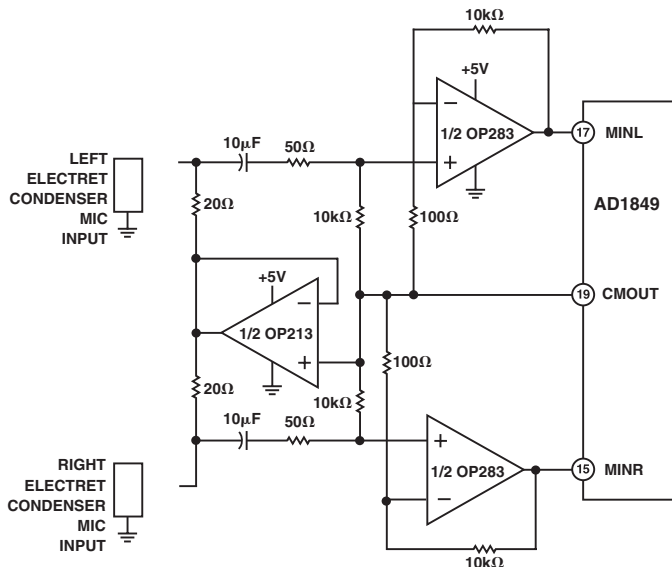


Figure 5. Low Noise Stereo Microphone Amplifier for Multimedia Sound CODEC

## A 3 V 50 Hz/60 Hz Active Notch Filter with False Ground

To process ac signals, it may be easier to use a false-ground bias rather than the negative supply as a reference ground. This would reject the power-line frequency interference which can oftentimes obscure low frequency physiological signals, such as heart rates, blood pressures, EEGs, and ECGs.

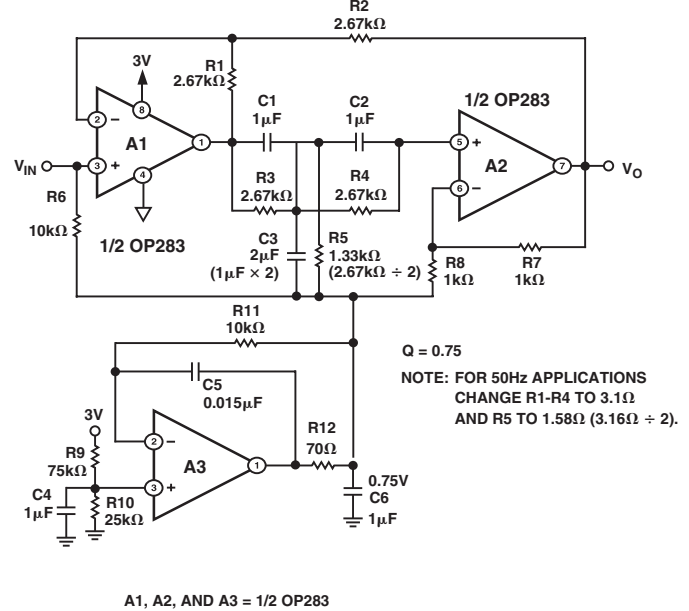


Figure 6. 3 V Supply 50 Hz/60 Hz Notch Filter with Pseudo Ground

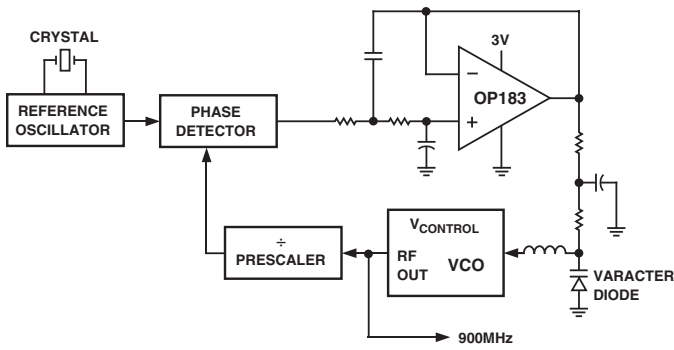
Figure 6 shows a 50 Hz/60 Hz active notch filter for eliminating line noise in patient monitoring equipment. It has several kilohertz bandwidth and is not sensitive to false-ground perturbations. The simple false-ground circuit shown achieves good rejection of low frequency interference using standard off-the-shelf components.

Amplifier A3 biases A1 and A2 to the middle of their input common-mode range. When operating on a 3 V supply, the center of the OP283’s common-mode range is 0.75 V. This notch filter effectively squelches 60 Hz pickup at a filter Q of 0.75. To reject 50 Hz interference, change the resistors in the twin-T section (R1 through R5) from 2.67 kΩ to 3.16 kΩ.

The filter section uses an OP283 dual op amp in a twin-T configuration whose frequency selectivity is very sensitive to the relative matching of the capacitors and resistors in the twin-T section. Mylar is the material of choice for the capacitors, and the relative matching of the capacitors and resistors determines the filter’s pass band symmetry. Using 1% resistors and 5% capacitors produces satisfactory results.

## A Low Voltage Frequency Synthesizer for Wireless Transceiver

The OP183’s low noise and the low voltage operation capability serves well for the loop filter of a frequency synthesizer. Figure 7 shows a typical application in a radio transceiver. The phase noise performance of the synthesizer depends on low noise contribution from each component in the loop as the noise is amplified by the frequency division factor of the prescaler.



The resistors used in the low-pass filter should be of low to moderate values to reduce noise contribution due to the input bias current as well as the resistors themselves. The filter cutoff frequency should be chosen to optimize the loop constant.

Figure 7. A Low Voltage Frequency Synthesizer for a Wireless Transceiver

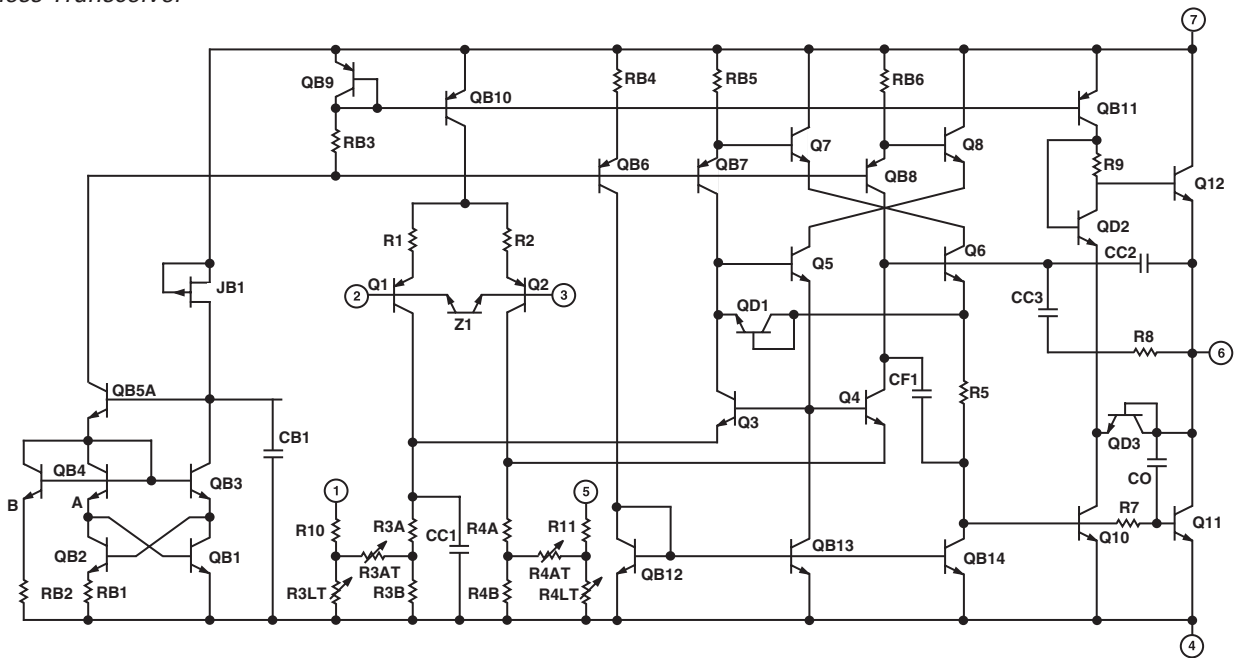


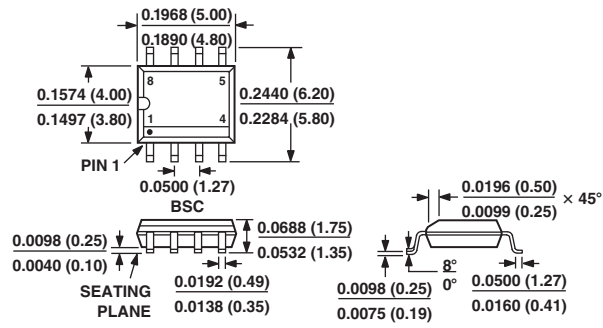
Figure 8. OP183 Simplified Schematic



**OUTLINE DIMENSIONS**

Dimensions shown in inches and (mm).

**8-Lead Narrow-Body SO  
(SO-8)**



# Revision History

<b>Location</b>	<b>Page</b>
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