

## Description

The TLC27L1 operational amplifier combines a wide range of input offset-voltage grades with low offset-voltage drift and high input impedance. The TLC27L1 is a low-bias version of the TLC271 programmable amplifier.

Three offset-voltage grades are available, ranging from the low-cost TLC27L1 (10mV) to the TLC27L1B (2mV) low-offset version. The devices are offered in both commercial and industrial operating temperature ranges.

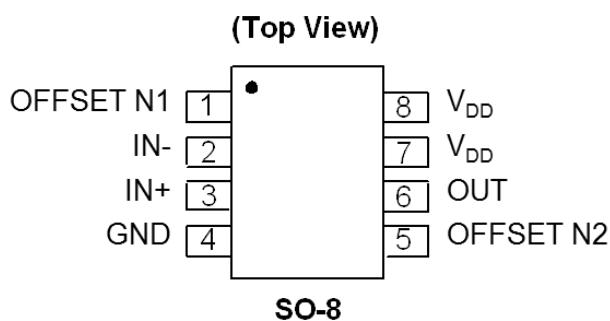
The extremely high input impedance and low bias currents, in conjunction with good common-mode rejection and supply voltage rejection, make these devices a good choice for new state-of-the-art designs as well as for upgrading existing designs.

The devices also exhibit low-voltage single-supply operation, with a common-mode input-voltage range including the negative rail.

## Features

- Wide range of supply voltages over specified temperature range:  
0°C to +70°C . . . 3 V to 16 V  
–40°C to +85°C . . . 4 V to 16 V
- Single-Supply Operation
- Common-Mode Input Voltage Range  
Extends Below the Negative Rail
- Low Noise:  
68nV/√Hz typical @ f = 1kHz
- Output Voltage Range Includes Negative Rail
- High Input Impedance
- Designed-In Latch-Up Immunity
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- Halogen and Antimony Free. "Green" Device (Note 3)**

## Pin Assignments



## Applications

The TLC27L1 is the low power version of the TLC271. It offers low power for applications requiring long battery life. For applications that require more performance consider the TLC271.

The TLC27L1 is well suited to many consumer audio, industrial and other low power applications. Consider carefully the bandwidth and slew rate requirements for a specific application.

- Audio  
Microphone Preamplifier  
Filtering – Equalizers  
Signal Amplification
- Industrial  
Power Supply  
Instrumentation  
Metering
- Medical  
Portable Meters and Measurement  
Instrumentation

Notes:

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

## Ordering Information

Device	Package Code	Offset Voltage	Operating Temperature Range	Packaging (Note 4)	13" Tape and Reel	
					Quantity	Part Number Suffix
TLC27L1CS-13	S	10mV	0 to +70°C	SO-8	2500/Tape & Reel	-13
TLC27L1ACS-13	S	5mV	0 to +70°C	SO-8	2500/Tape & Reel	-13
TLC27L1BCS-13	S	2mV	0 to +70°C	SO-8	2500/Tape & Reel	-13
TLC27L1IS-13	S	10mV	-40 to +85°C	SO-8	2500/Tape & Reel	-13
TLC27L1AIS-13	S	5mV	-40 to +85°C	SO-8	2500/Tape & Reel	-13
TLC27L1BIS-13	S	2mV	-40 to +85°C	SO-8	2500/Tape & Reel	-13

Note: 4. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at <http://www.diodes.com/datasheets/ap02001.pdf>.

## Pin Descriptions

Pin Name	Pin Number	Description
OFFSET N1	1	Offset Control Inverting Input
IN-	2	Inverting Input
IN+	3	Non-Inverting Input
GND	4	Ground
OFFSET N2	5	Offset Control Non-Inverting Input
OUT	6	Output
V <sub>DD</sub>	7	Supply
V <sub>DD</sub>	8	Supply

## Absolute Maximum Ratings (Notes 5, 6, 7, 8, 9)

Symbol	Parameter	Rating	Unit
$V_{DD}$	Supply Voltage: (Note 6)	18	V
$V_{ID}$	Differential Input Voltage (Note 7)	$\pm V_{DD}$	V
$V_{IN}$	Input Voltage Range (either input)	-0.3 to $V_{DD}$	V
$I_{IN}$	Input Current	$\pm 5$	mA
$I_O$	Output current	$\pm 30$	mA
	Output Short-Circuit to GND (Note 8)	Continuous	—
$P_D$	Power Dissipation (Note 9)	1065	mW
$T_A$	Operating Temperature Range	C Grade	0 to +70
		I Grade	-40 to +85
$T_J$	Operating Junction Temperature	150	°C
$T_{ST}$	Storage Temperature Range	-65 to +150	°C
ESD HBM	Human Body Model ESD Protection (1.5kΩ in series with 100pF)	1.5	kV

Notes:

- 5. Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only; 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-rated conditions for extended periods may affect device reliability.
- 6. All voltage values, except differential voltages, are with respect to ground.
- 7. Differential input voltages are at  $IN+$  with respect to  $IN-$ .
- 8. The output may be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded.
- 9. For operating at high temperatures, the TLC27L1 must be derated 8.5mW/°C to zero based on a +150°C maximum junction temperature and a thermal resistance of +117 °C/W when the device is soldered to a printed circuit board, operating in a still air ambient.

## Recommended Operating Conditions

Symbol	Parameter	C grade		I grade		Unit
		Min	Max	Min	Max	
$V_{DD}$	Supply Voltage	3	16	4	16	V
$V_{IC}$	Common Mode Input Voltage	$V_{DD} = 5V$	-0.2	3.5	-0.2	3.5
		$V_{DD} = 10V$	-0.2	8.5	-0.2	8.5
$T_A$	Operating Free Air Temperature	0	+70	-40	+85	°C

## Electrical Characteristics

Parameter			Conditions	T <sub>A</sub>	TLC27L1C, TLC27L1AC, TLC27L1BC						Unit	
					V <sub>DD</sub> = 5V			V <sub>DD</sub> = 10V				
					Min	Typ	Max	Min	Typ.	Max		
V <sub>IO</sub>	Input Offset Voltage	TLC27L1C	V <sub>O</sub> = 1.4V V <sub>IC</sub> = 0V R <sub>S</sub> = 50Ω R <sub>L</sub> = 1MΩ	+25°C	—	1.1	10	—	1.1	10	mV	
				0 to +70°C	—	—	12	—	—	12		
		TLC27L1AC		+25°C	—	0.9	5	—	0.9	5		
				0 to +70°C	—	—	6.5	—	—	6.5		
		TLC27L1BC		+25°C	—	0.24	2	—	0.26	2		
				0 to +70°C	—	—	3	—	—	3		
α <sub>VIO</sub>	Average Temperature Coefficient of Input Offset Voltage	—		+25 to +70°C	1.1			1			μV/°C	
I <sub>IO</sub>	Input Offset Current (Note 10)	V <sub>O</sub> = V <sub>DD</sub> /2, V <sub>IC</sub> = V <sub>DD</sub> /2	+25°C +70°C	—	0.1	60	—	0.1	60	—	pA	
				—	7	300	—	8	300	—		
I <sub>IB</sub>	Input Bias Current (Note 10)	V <sub>O</sub> = V <sub>DD</sub> /2, V <sub>IC</sub> = V <sub>DD</sub> /2	+25°C +70°C	—	0.6	60	—	0.7	60	—	pA	
				—	40	600	—	50	600	—		
V <sub>ICR</sub>	Common Mode Input Voltage (Note 11)	—	+25°C 0°C to +70°C	-0.2 to 4	-0.3 to 4.2	—	-0.2 to 9	-0.3 to 9.2	—	—	V	
				-0.2 to 3.5	—	—	-0.2 to 8.5	—	—	—	V	
V <sub>OH</sub>	High Level Output Voltage	V <sub>ID</sub> = 100mV, R <sub>L</sub> = 1MΩ	+25°C 0°C +70°C	3.2	4.1	—	8	8.9	—	—	V	
				3	4.1	—	7.8	8.9	—	—		
				3	4.2	—	7.8	8.9	—	—		
V <sub>OL</sub>	Low Level Output Voltage	V <sub>ID</sub> = -100mV, I <sub>OL</sub> = 0	+25°C 0°C +70°C	—	0	50	—	0	50	—	mV	
				—	0	50	—	0	50	—		
				—	0	50	—	0	50	—		
A <sub>VD</sub>	Large Signal Differential Voltage Gain	R <sub>L</sub> = 1MΩ (Note 12)	+25°C 0°C +70°C	50	520	—	50	870	—	—	V/mV	
				50	700	—	50	1030	—	—		
				50	380	—	50	660	—	—		
CMRR	Common Mode Rejection Ratio	V <sub>IC</sub> = V <sub>ICRmin</sub>	+25°C 0°C +70°C	65	94	—	65	97	—	—	dB	
				60	95	—	60	97	—	—		
				60	95	—	60	97	—	—		
k <sub>SVR</sub>	Supply Voltage Rejection Ratio (ΔV <sub>DD</sub> /ΔV <sub>IO</sub> )	V <sub>DD</sub> = 5V to 10V V <sub>O</sub> = 1.4V	+25°C 0°C +70°C	70	97	—	70	97	—	—	dB	
				60	97	—	60	97	—	—		
				60	98	—	60	98	—	—		
I <sub>DD</sub>	Supply Current	V <sub>O</sub> = V <sub>DD</sub> /2, V <sub>IC</sub> = V <sub>DD</sub> /2, No Load	+25°C 0°C +70°C	—	10	17	—	14	23	—	μA	
				—	12	21	—	18	33	—		
				—	8	14	—	11	20	—		

Notes:

10. The typical values of input bias current and input offset current below 5pA were calculated.
11. This range also applies to each input individually.
12. At V<sub>DD</sub> = 5V, V<sub>O</sub> = 0.25V to 2V; at V<sub>DD</sub> = 10V, V<sub>O</sub> = 1V to 6V.

## Electrical Characteristics

Parameter			Conditions	T <sub>A</sub>	TLC27L1I, TLC27L1AI, TLC27L1BI						Unit	
					V <sub>DD</sub> = 5V			V <sub>DD</sub> = 10V				
					Min	Typ	Max	Min	Typ.	Max		
V <sub>IO</sub>	Input Offset Voltage	TLC27L1I	+25°C	—	1.1	10	—	1.1	10	—	mV	
			-40° to 85°C	—	—	13	—	—	—	13		
			+25°C	—	0.9	5	—	0.9	5	—		
		TLC27L1AI	-40° to +85°C	—	—	7	—	—	—	7		
			+25°C	—	0.24	2	—	0.26	2	—		
			-40° to +85°C	—	—	3.5	—	—	—	3.5		
α <sub>VIO</sub>	Average Temperature Coefficient of Input Offset Voltage	—	+25°C to +85°C	—	1.1	—	—	1	—	—	μV/°C	
I <sub>IO</sub>	Input Offset Current (Note 13)	V <sub>O</sub> = V <sub>DD</sub> /2	+25°C	—	0.1	60	—	0.1	60	—	pA	
		V <sub>IC</sub> = V <sub>DD</sub> /2	+85°C	—	24	1000	—	26	1000	—		
I <sub>IB</sub>	Input Bias Current (Note 13)	V <sub>O</sub> = V <sub>DD</sub> /2	+25°C	—	0.6	60	—	0.7	60	—	pA	
		V <sub>IC</sub> = V <sub>DD</sub> /2	+85°C	—	200	2000	—	220	2000	—		
V <sub>ICR</sub>	Common Mode Input Voltage (Note 14)	—	+25°C	-0.2 to 4	-0.3 to 4.2	—	-0.2 to 9	-0.3 to 9.2	—	—	V	
			-40° to +85°C	-0.2 to 3.5	—	—	-0.2 to 8.5	—	—	—	V	
V <sub>OH</sub>	High Level Output Voltage	V <sub>ID</sub> = 100mV, R <sub>L</sub> = 1MΩ	+25°C	3	4.1	—	8	8.9	—	—	V	
			-40°C	3	4.1	—	7.8	8.9	—	—		
			+85°C	3	4.2	—	7.8	8.9	—	—		
V <sub>OL</sub>	Low Level Output Voltage	V <sub>ID</sub> = -100mV, I <sub>OL</sub> = 0	+25°C	—	0	50	—	0	50	—	mV	
			-40°C	—	0	50	—	0	50	—		
			+85°C	—	0	50	—	0	50	—		
A <sub>VD</sub>	Large Signal Differential Voltage Gain	R <sub>L</sub> = 1MΩ (Note 15)	+25°C	50	520	—	50	870	—	—	V/mV	
			-40°C	50	900	—	50	1550	—	—		
			+85°C	50	330	—	50	585	—	—		
CMRR	Common Mode Rejection Ratio	V <sub>IC</sub> = V <sub>ICRmin</sub>	+25°C	65	94	—	65	97	—	—	dB	
			-40°C	60	95	—	60	97	—	—		
			+85°C	60	95	—	60	98	—	—		
k <sub>SVR</sub>	Supply Voltage Rejection Ratio (ΔV <sub>DD</sub> /ΔV <sub>IO</sub> )	V <sub>DD</sub> = 5V to 10V V <sub>O</sub> = 1.4V	+25°C	70	97	—	70	97	—	—	dB	
			-40°C	60	97	—	60	97	—	—		
			+85°C	60	98	—	60	98	—	—		
I <sub>DD</sub>	Supply Current	V <sub>O</sub> = V <sub>DD</sub> /2 V <sub>IC</sub> = V <sub>DD</sub> /2 No load	+25°C	—	10	17	—	14	23	—	μA	
			-40°C	—	16	27	—	25	43	—		
			+85°C	—	17	13	—	10	18	—		

Notes: 13. The typical values of input bias current and input offset current below 5pA were calculated.

14. This range also applies to each input individually.

15. At V<sub>DD</sub> = 5V, V<sub>O</sub> = 0.25V to 2V; at V<sub>DD</sub> = 10V, V<sub>O</sub> = 1V to 6V.

## Electrical Characteristics

<b>V<sub>DD</sub> = 5V</b>									
<b>Parameter</b>		<b>Conditions</b>		<b>T<sub>A</sub></b>	<b>TLC27L1C, TLC27L1AC, TLC27L1BC</b>		<b>Unit</b>		
					<b>Min</b>	<b>Typ</b>			
SR	Slew Rate at Unity Gain	$R_L = 1\text{M}\Omega$ $C_L = 20\text{pF}$ See Figure 31	$V_{I(PP)} = 1\text{V}$	+25°C	—	0.03	—		
				0°C	—	0.04	—		
				+70°C	—	0.03	—		
		See Figure 31	$V_{I(PP)} = 2.5\text{V}$	+25°C	—	0.03	—		
				0°C	—	0.03	—		
				+70°C	—	0.02	—		
V <sub>n</sub>	Equivalent Input Noise Voltage	$F = 1\text{kHz}$ , $R_S = 20\Omega$ See Figure 32		+25°C	—	68	—		
B <sub>OM</sub>	Maximum Output Swing Bandwidth	$V_O = V_{OH}$ , $C_L = 20\text{pF}$ , $R_L = 1\text{M}\Omega$ See Figure 31		+25°C	—	5	—		
				0°C	—	6	—		
				+70°C	—	4.5	—		
B <sub>1</sub>	Unity Gain Bandwidth	$V_I = 10\text{mV}$ , $C_L = 20\text{pF}$ See Figure 33		+25°C	—	85	—		
				0°C	—	100	—		
				+70°C	—	65	—		
$\phi_m$	Phase Margin	$F = B_1$ , $V_I = 10\text{mV}$ , $C_L = 20\text{pF}$ See Figure 33		+25°C	—	34°	—		
				0°C	—	36°	—		
				+70°C	—	30°	—		
<b>V<sub>DD</sub> = 10V</b>									
<b>Parameter</b>		<b>Conditions</b>		<b>T<sub>A</sub></b>	<b>TLC27L1C, TLC27L1AC, TLC27L1BC</b>		<b>Unit</b>		
					<b>Min</b>	<b>Typ</b>			
SR	Slew Rate at Unity Gain	$R_L = 1\text{M}\Omega$ , $C_L = 20\text{pF}$ See Figure 31	$V_{I(PP)} = 1\text{V}$	+25°C	—	0.05	—		
				0°C	—	0.05	—		
				+70°C	—	0.04	—		
		See Figure 31	$V_{I(PP)} = 5.5\text{V}$	+25°C	—	0.04	—		
				0°C	—	0.05	—		
				+70°C	—	0.04	—		
V <sub>n</sub>	Equivalent Input Noise Voltage	$F = 1\text{kHz}$ , $R_S = 20\Omega$ See Figure 32		+25°C	—	68	—		
B <sub>OM</sub>	Maximum Output Swing Bandwidth	$V_O = V_{OH}$ , $C_L = 20\text{pF}$ , $R_L = 1\text{M}\Omega$ See Figure 31		+25°C	—	1	—		
				0°C	—	1.3	—		
				+70°C	—	0.9	—		
B <sub>1</sub>	Unity Gain Bandwidth	$V_I = 10\text{mV}$ , $C_L = 20\text{pF}$ See Figure 33		+25°C	—	110	—		
				0°C	—	125	—		
				+70°C	—	90	—		
$\phi_m$	Phase Margin	$F = B_1$ , $V_I = 10\text{mV}$ , $C_L = 20\text{pF}$ See Figure 33		+25°C	—	38°	—		
				0°C	—	40°	—		
				+70°C	—	34°	—		

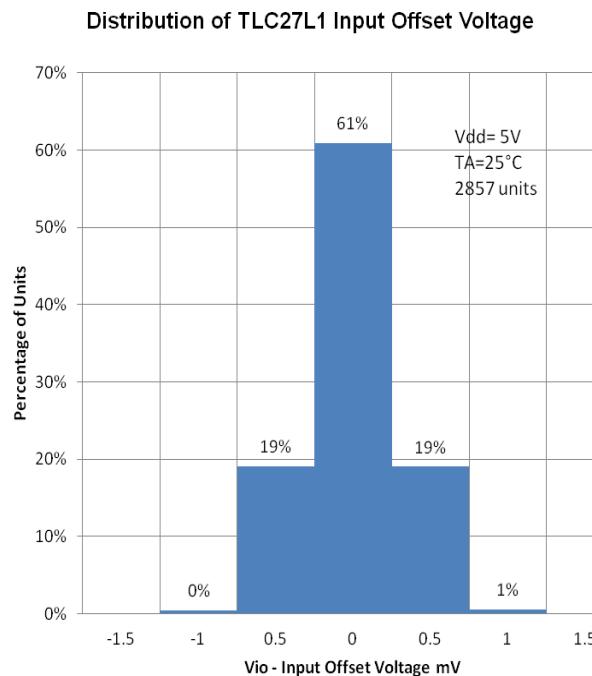
## Electrical Characteristics

$V_{DD} = 5V$									
Parameter		Conditions		$T_A$	TLC27L1I, TLC27L1AI, TLC27L1BI		Unit		
					Min	Typ			
SR	Slew Rate at Unity Gain	$R_L = 1M\Omega$ $C_L = 20pF$ See Figure 31	$V_{I(PP)} = 1V$	+25°C	—	0.03	—		
				-40°	—	0.04	—		
				+85°C	—	0.03	—		
				+25°C	—	0.03	—		
		$V_{I(PP)} = 2.5V$		-40°	—	0.04	—		
				+85°C	—	0.02	—		
				+25°C	—	68	—		
				nV/ $\sqrt{Hz}$					
$B_{OM}$	Maximum Output Swing Bandwidth	$V_O = V_{OH}$ , $C_L = 20pF$ , $R_L = 1M\Omega$ See Figure 31		+25°C	—	5	—		
				-40°	—	7	—		
				+85°C	—	4	—		
$B_1$	Unity Gain Bandwidth	$V_I = 10mV$ , $C_L = 20pF$ See Figure 33		+25°C	—	85	—		
				-40°	—	130	—		
				+85°C	—	55	—		
$\phi_m$	Phase Margin	$F = B_1$ , $V_I = 10mV$ , $C_L = 20pF$ See Figure 33		+25°C	—	34°	—		
				-40°	—	38°	—		
				+85°C	—	28°	—		
$V_{DD} = 10V$									
Parameter		Conditions		$T_A$	TLC27L1I, TLC27L1AI, TLC27L1BI		Unit		
					Min	Typ			
SR	Slew Rate at Unity Gain	$R_L = 1M\Omega$ $C_L = 20pF$ See Figure 31	$V_{I(PP)} = 1V$	+25°C	—	0.05	—		
				-40°	—	0.06	—		
				+85°C	—	0.03	—		
				+25°C	—	0.04	—		
		$V_{I(PP)} = 5.5V$		-40°	—	0.05	—		
				+85°C	—	0.03	—		
				+25°C	—	68	—		
				nV/ $\sqrt{Hz}$					
$B_{OM}$	Maximum Output Swing Bandwidth	$V_O = V_{OH}$ , $C_L = 20pF$ , $R_L = 1M\Omega$ See Figure 31		+25°C	—	1	—		
				-40°	—	1.4	—		
				+85°C	—	0.8	—		
$B_1$	Unity Gain Bandwidth	$V_I = 10mV$ , $C_L = 20pF$ See Figure 33		+25°C	—	110	—		
				-40°	—	155	—		
				+85°C	—	80	—		
$\phi_m$	Phase Margin	$F = B_1$ , $V_I = 10mV$ , $C_L = 20pF$ See Figure 33		+25°C	—	38°	—		
				-40°	—	42°	—		
				+85°C	—	32°	—		

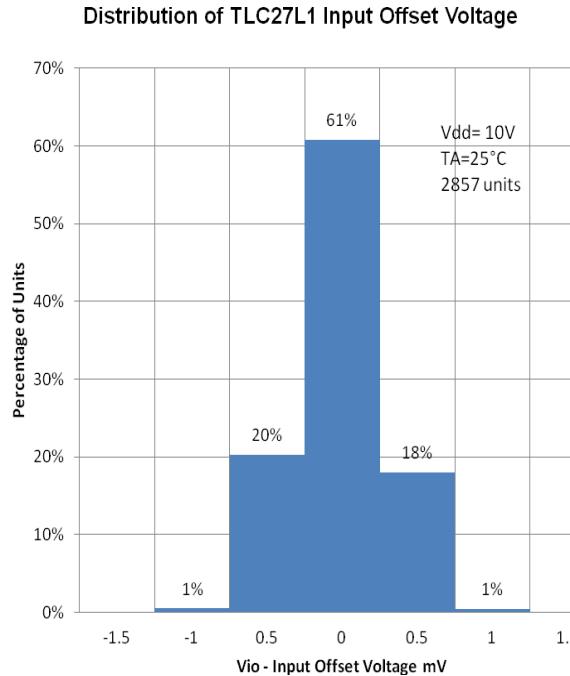
## Typical Performance Characteristics Table Index of Graphs

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	$I_{IO}$	vs. Free Air Temperature	15
$V_{IC}$	Common Mode Input Voltage	vs. Supply Voltage	16
$I_{DD}$	Supply Current	vs. Supply Voltage	17
		vs. Free Air Temperature	18
$SR$	Slew Rate	vs. Supply Voltage	19
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$I_{SEL}$	Bias Select Current	vs. Supply Voltage	21
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$B_1$	Unity Gain Bandwidth	vs. Free Air Temperature	23
		vs. Supply Voltage	24
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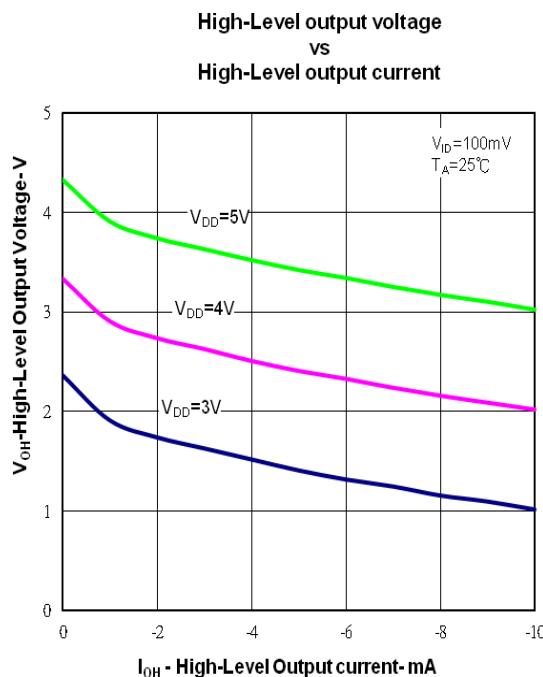
## Typical Performance Characteristics



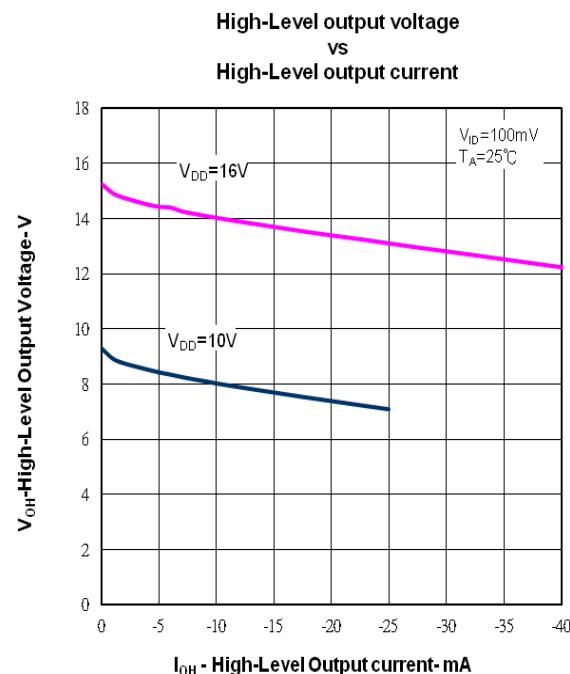
**Figure 1**



**Figure 2**



**Figure 3**



**Figure 4**

## Typical Performance Characteristics

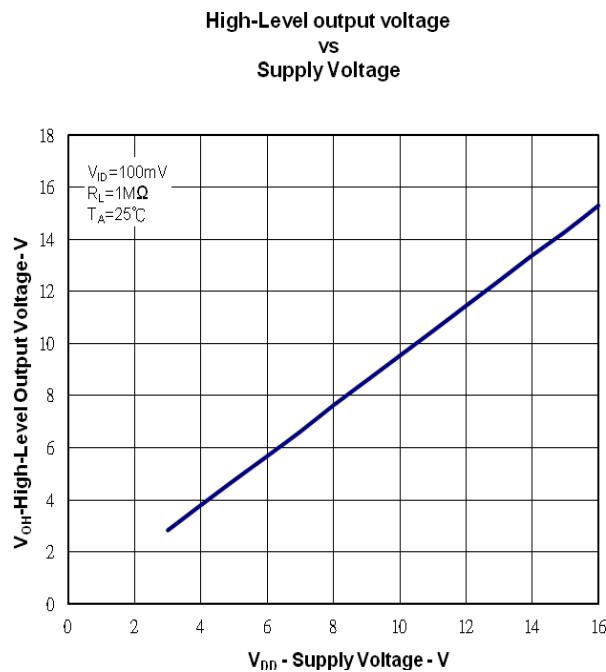


Figure 5

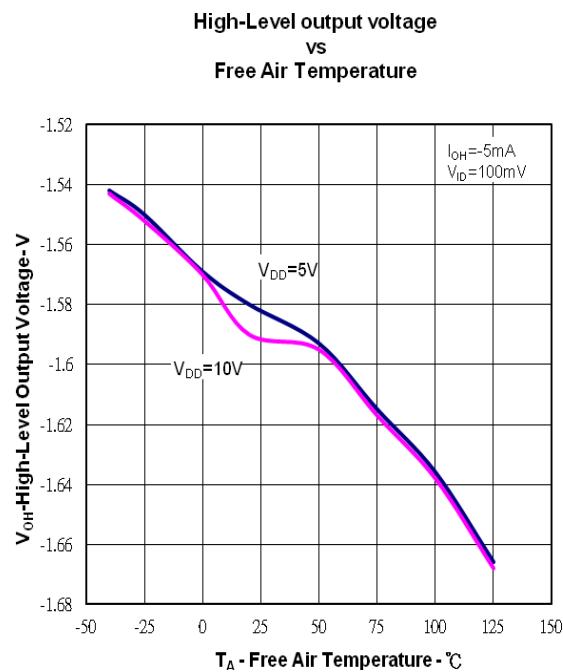


Figure 6

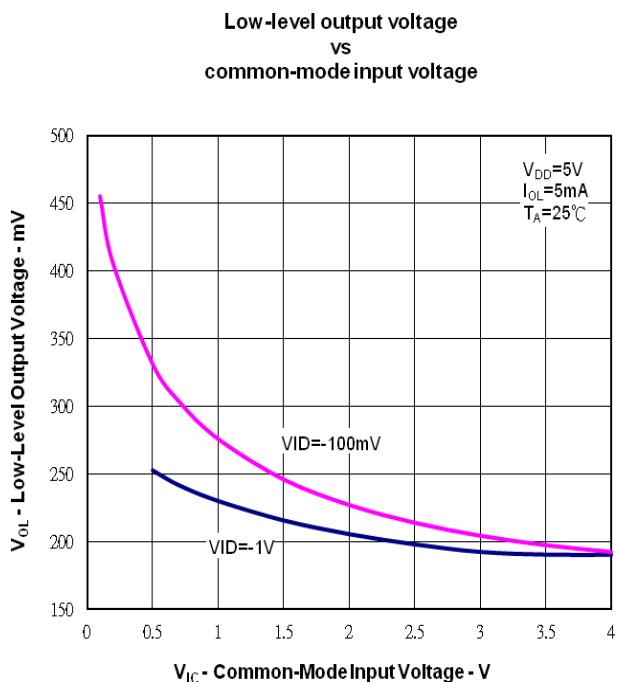


Figure 7

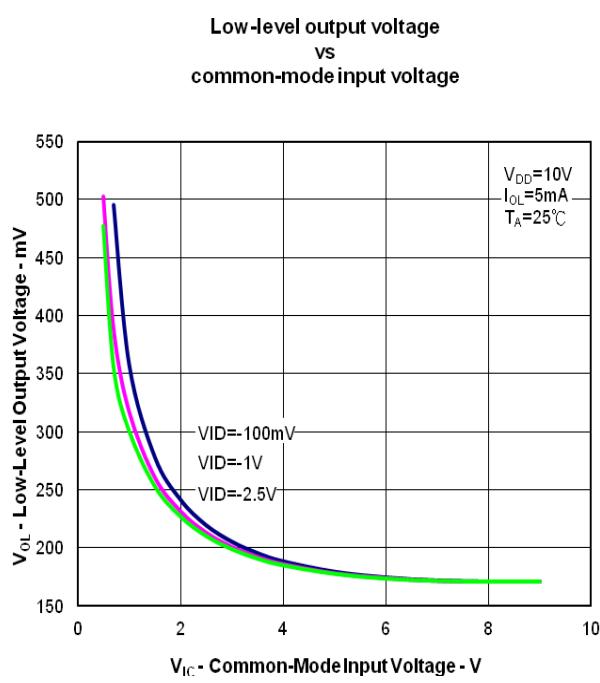


Figure 8

## Typical Performance Characteristics

Low-level output voltage  
vs  
Differential input voltage

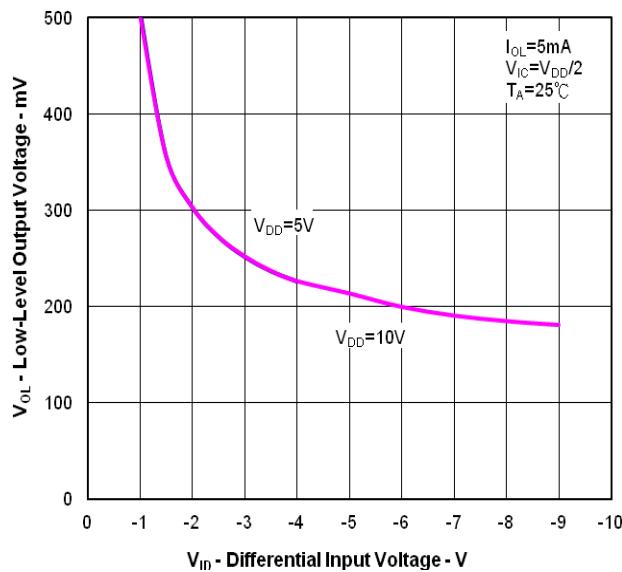


Figure 9

Low-level output voltage  
vs  
Differential input voltage

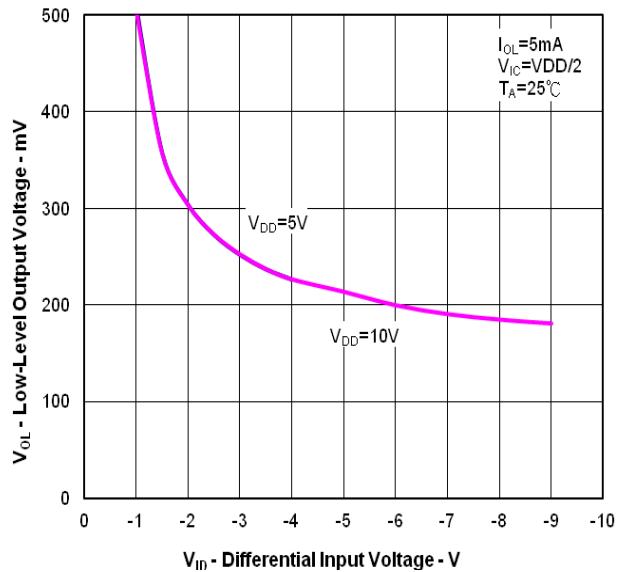


Figure 10

Low-level output voltage  
vs  
Low-level output current

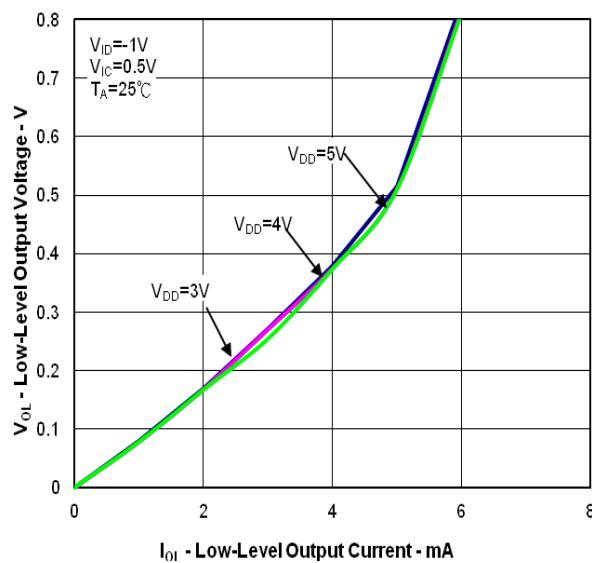


Figure 11

Low-level output voltage  
vs  
Low-level output current

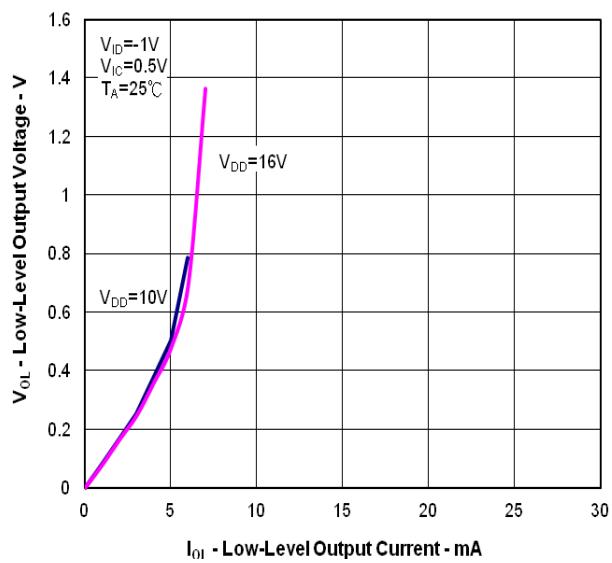


Figure 12

## Typical Performance Characteristics

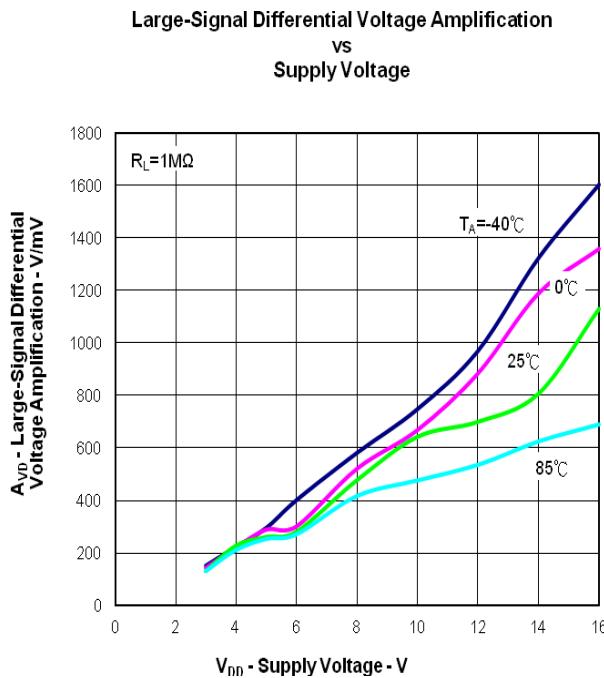


Figure 13

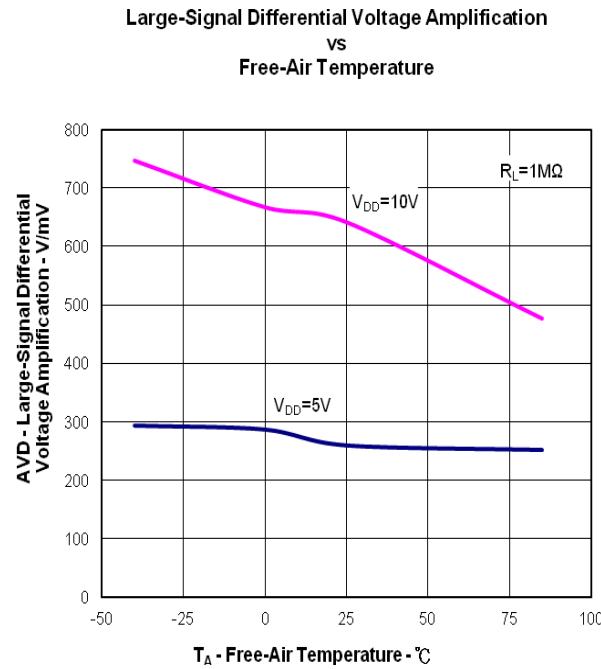


Figure 14

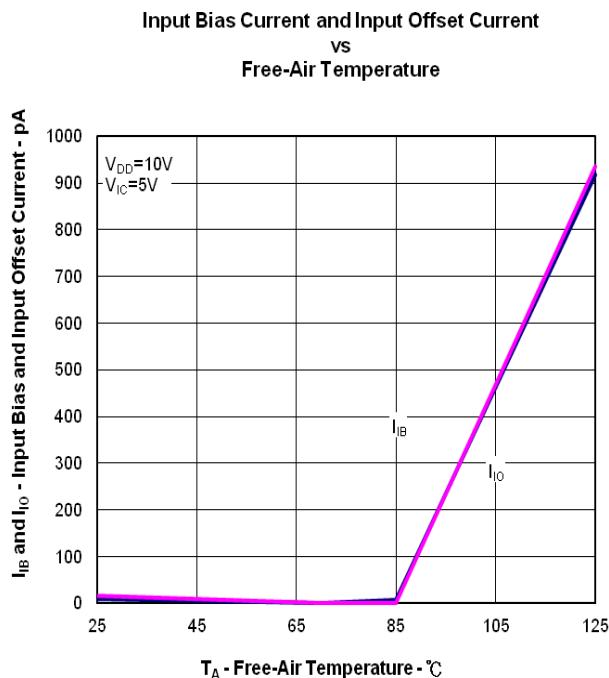


Figure 15

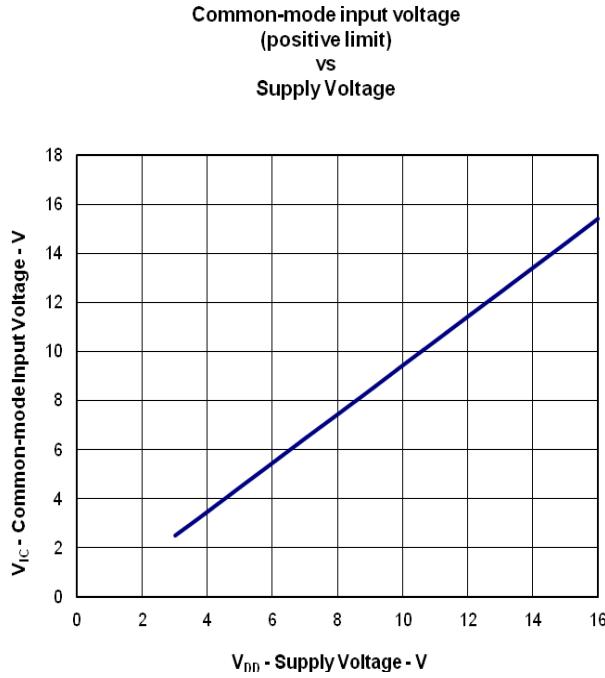


Figure 16

## Typical Performance Characteristics

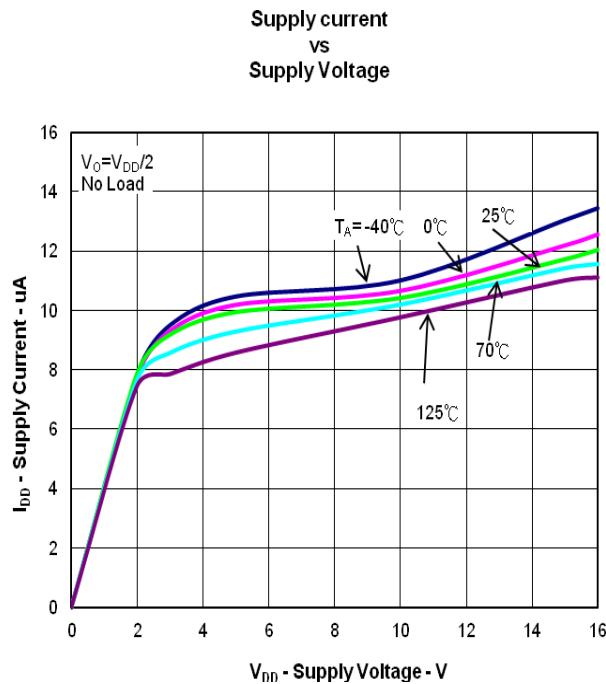


Figure 17

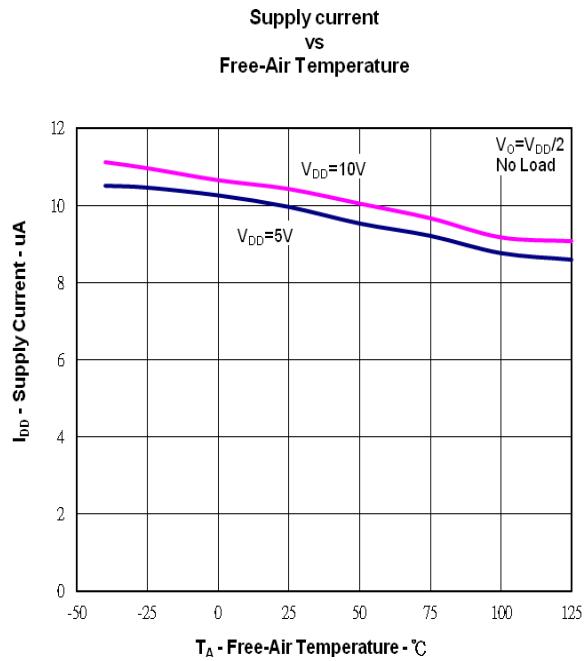


Figure 18

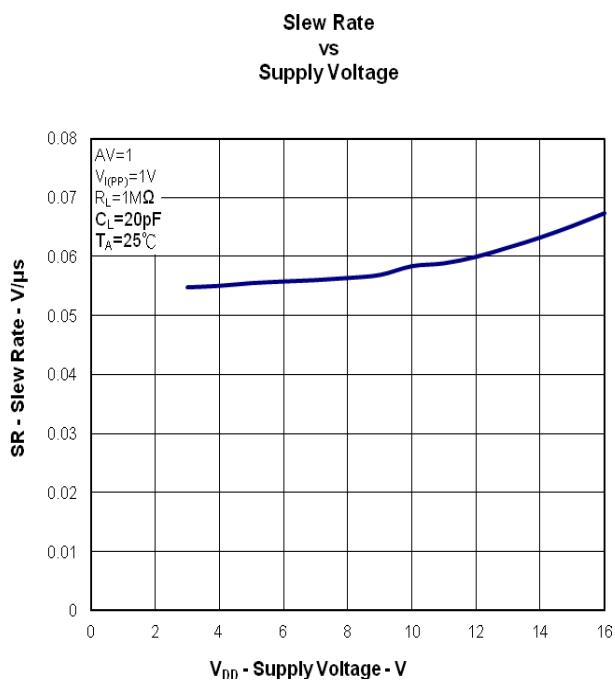


Figure 19

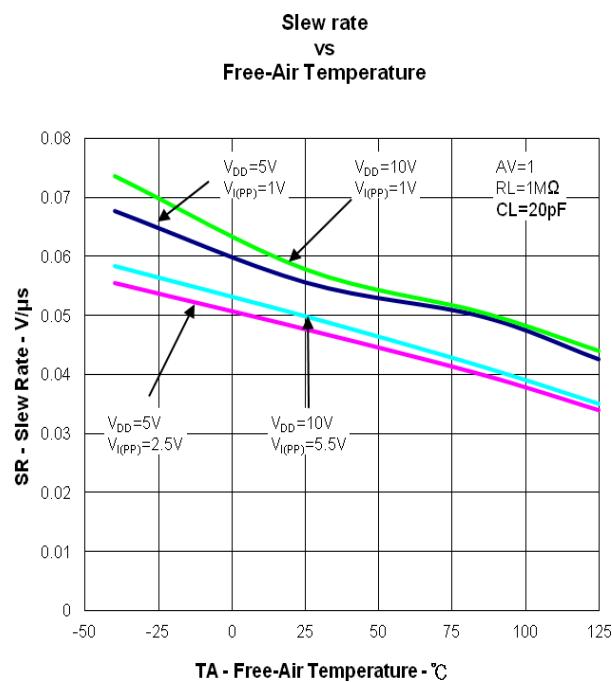


Figure 20

## Typical Performance Characteristics

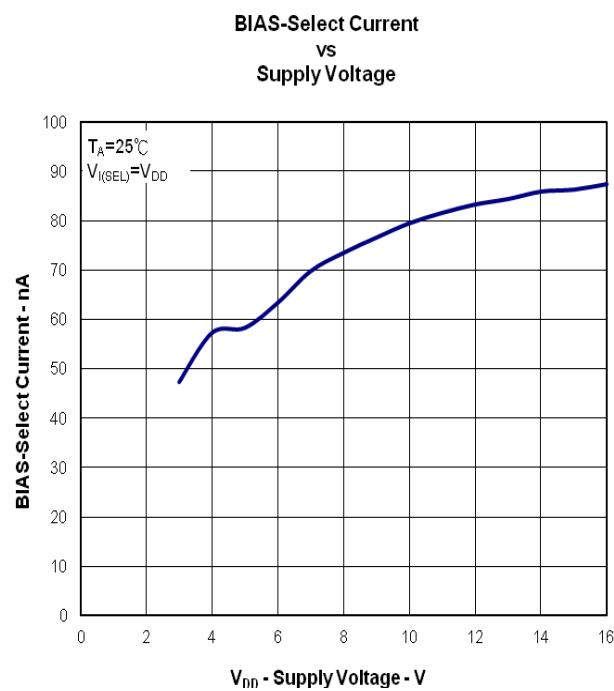


Figure 21

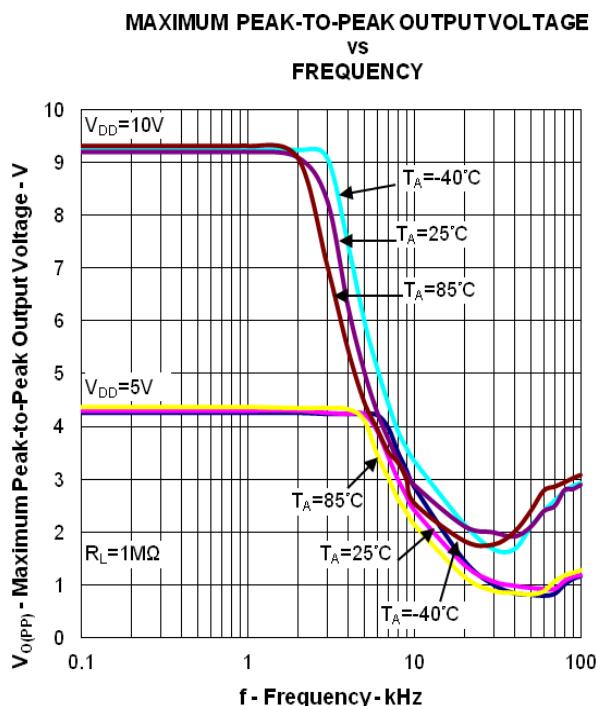


Figure 22

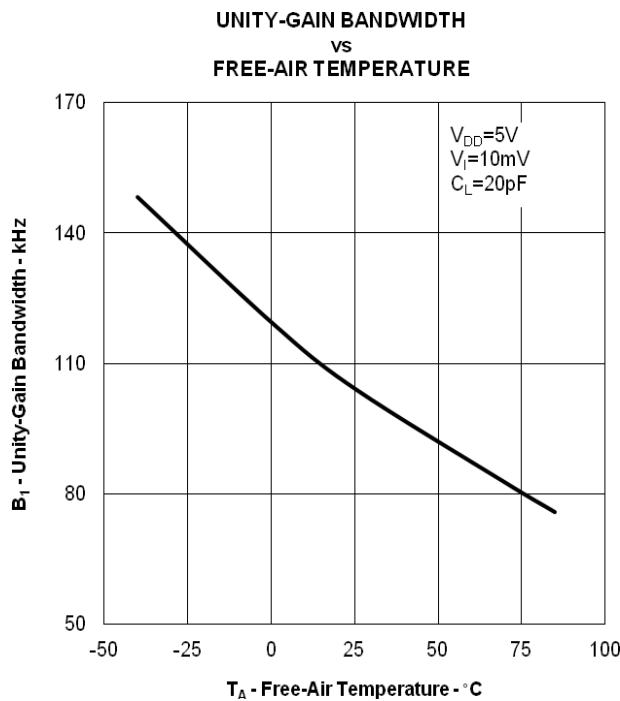


Figure 23

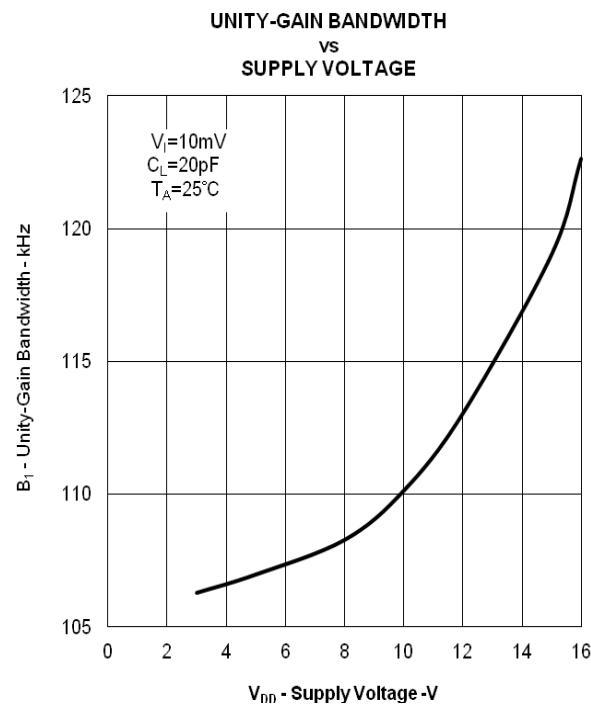


Figure 24

## Typical Performance Characteristics

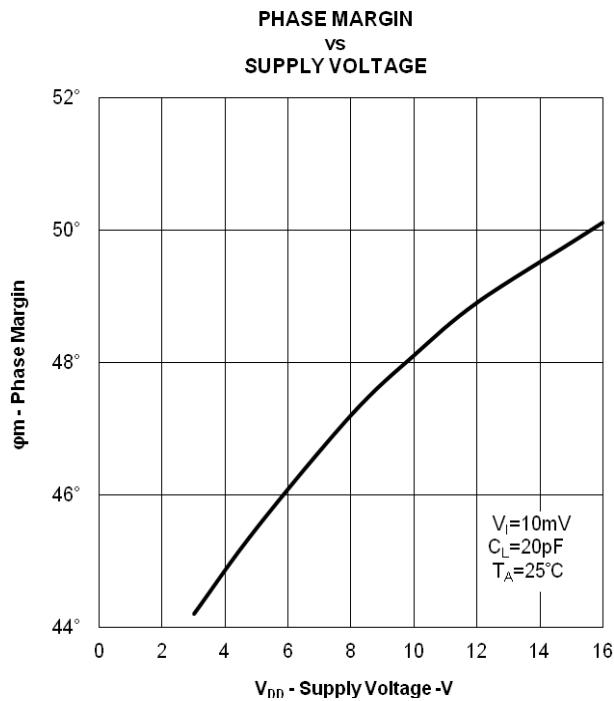


Figure 25

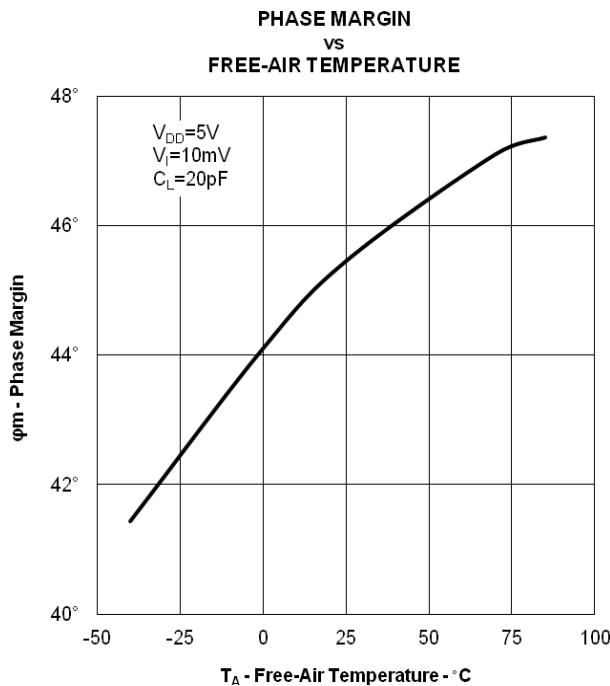


Figure 26

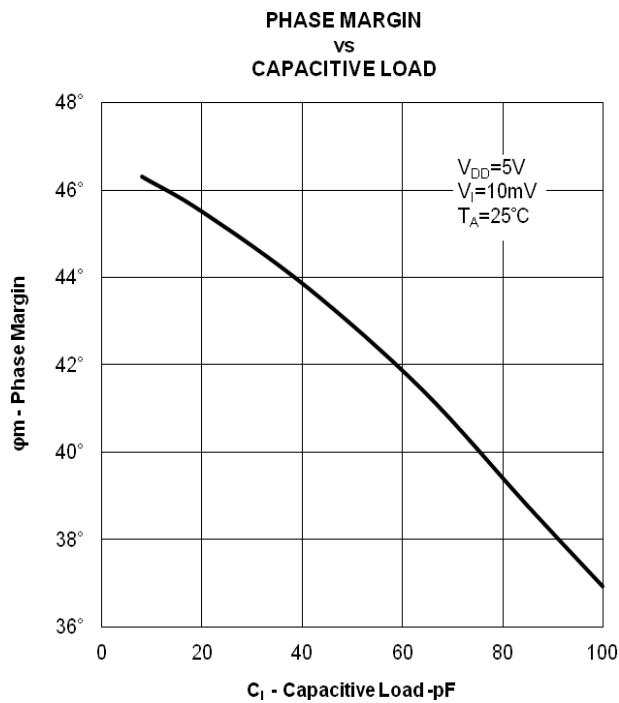


Figure 27

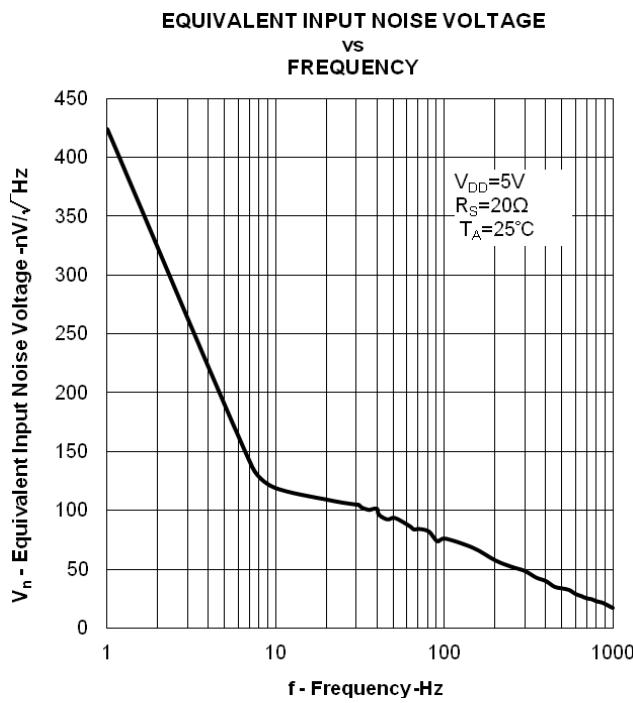


Figure 28

## Typical Performance Characteristics

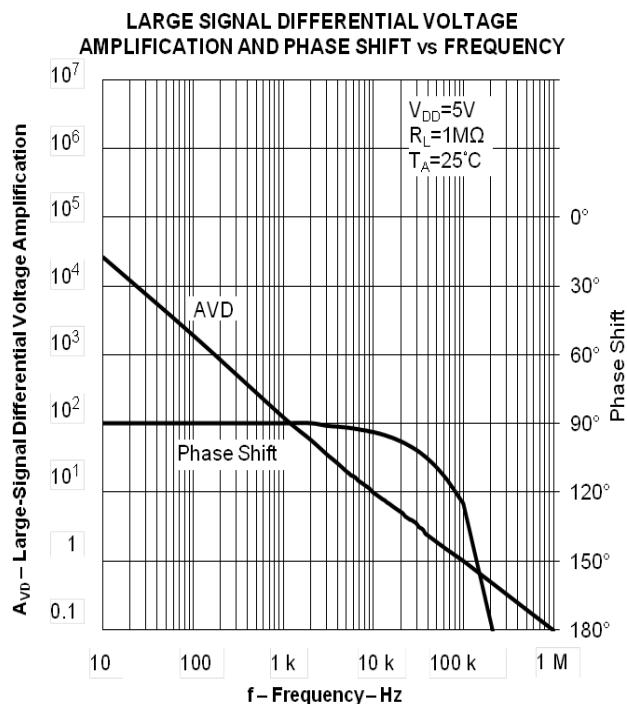


Figure 29

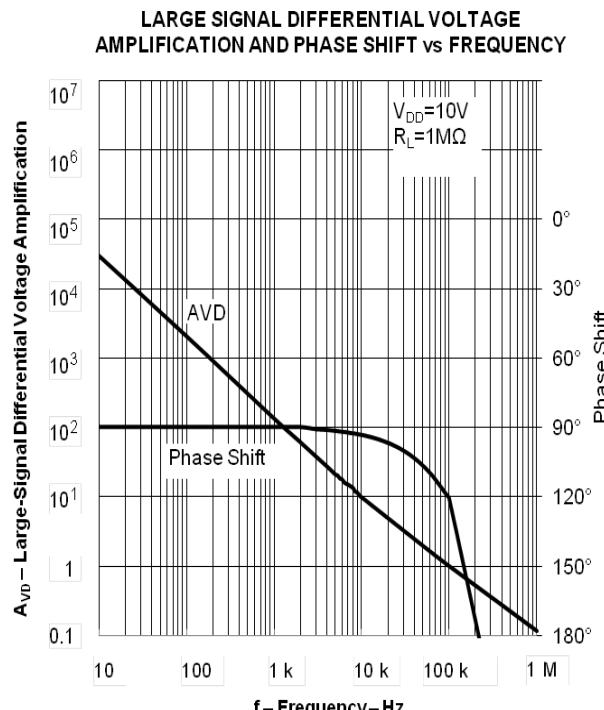


Figure 30

## Application Information

### Parameter measurement circuits

Because the TLC271 is optimized for single-supply operation, circuit configurations used for the various tests can present some difficulties since the input signal must be offset from ground. This issue can be avoided by testing the device with split supplies and the output load tied to the negative rail. Example circuits are shown below.

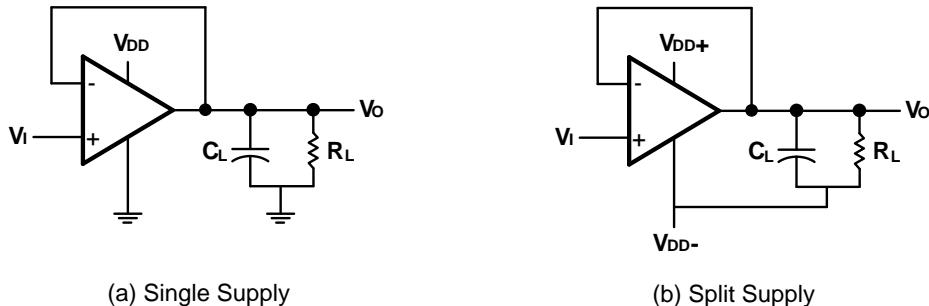


Figure 31 Measurement circuit with either single or split supply

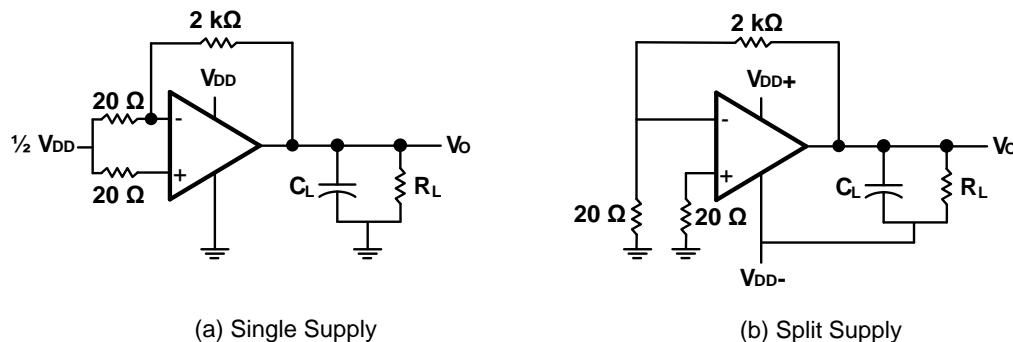


Fig 32 Noise measurement with single or split supply

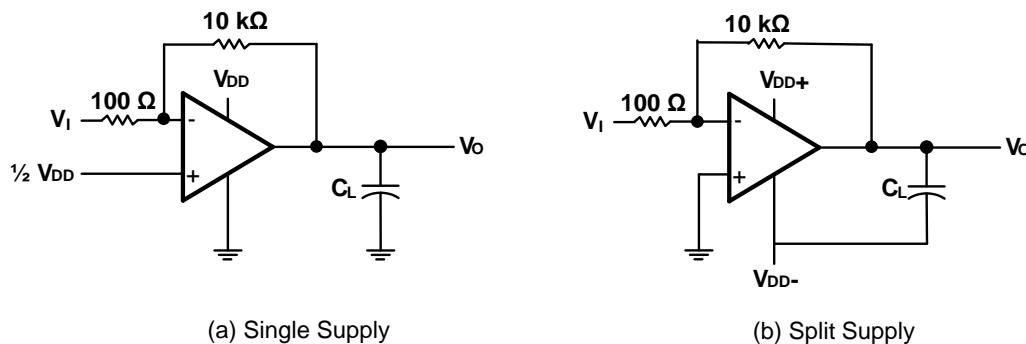
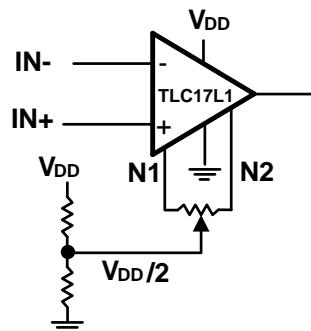


Figure 33 Gain of 100 with single or split supply

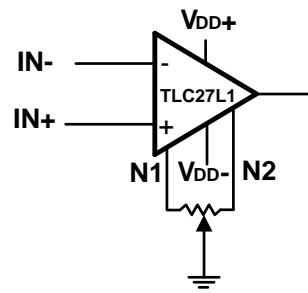
## Application Notes

## Offset Voltage Nulling Circuit

The TLC27L1 offers external input offset null control. Nulling of the input offset voltage may be achieved by adjusting a 100-k $\Omega$  potentiometer connected between the offset null terminals with the wiper connected as shown in Figure 31.



### (a) Single Supply

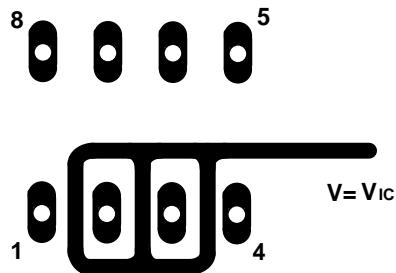


(b) Split Supply

### Figure 31 Offset Nulling Circuits

## Input Bias Current – Error Protection

The TLC27L1 has an extremely high input impedance. To use the inputs as a high impedance node, for example, greater than 100K, or to accurately measure bias current, it is necessary to place a guard ring around the input pins and drive the ring to a potential equivalent to the common mode input voltage. In many cases this common mode potential may exist as a part of the feedback circuit and can be obtained from one of the appropriate nodes. In the case for the SO8 package, pin 4 is connected to ground or Vdd-. Input pins 2 and 3 are normally well above the voltage on pin 4, so a large potential voltage on the order of several volts is likely between pins 3 and 4. To prevent interference with a 1 pA bias current, the board resistance will need to be in the order of gigaohms to have a minimum impact. The goal is to have the common mode potential on the guard ring, therefore reducing the stray voltage near the input pins to millivolts in normal applications. Any solder flux residue, excess moisture, humidity or board contamination will be detrimental to using the device in a high impedance input mode.



**Figure 32 Bias Current Guarding for High Input Impedance Applications**

## Typical Application Circuits

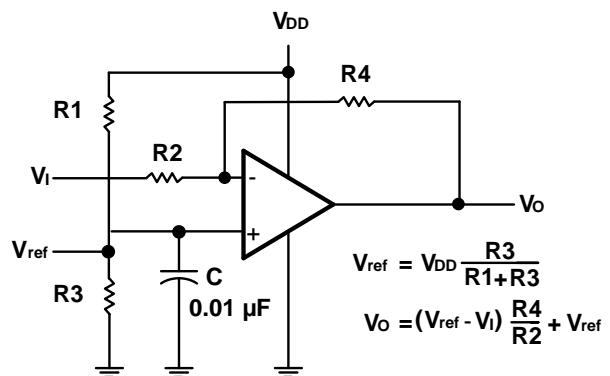


Figure 33 Inverting Amplifier With Voltage Reference

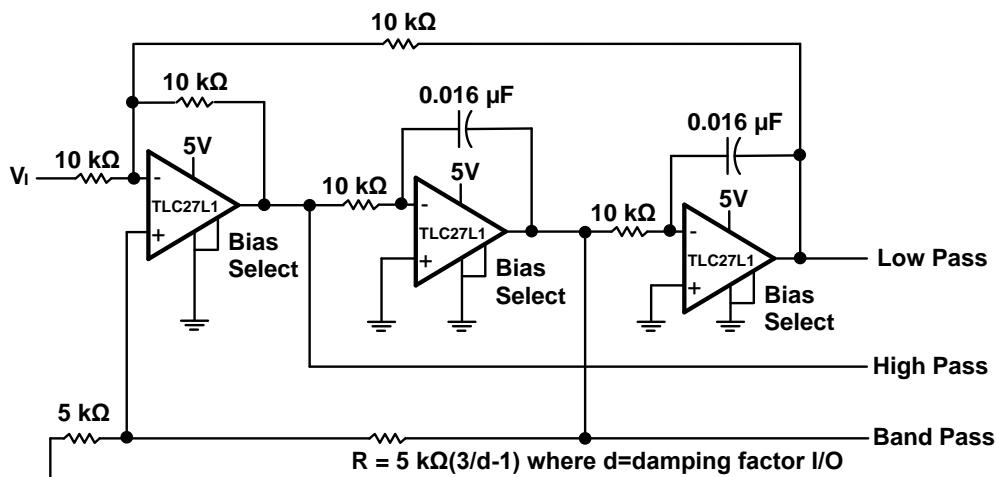


Figure 34 State Variable Filter

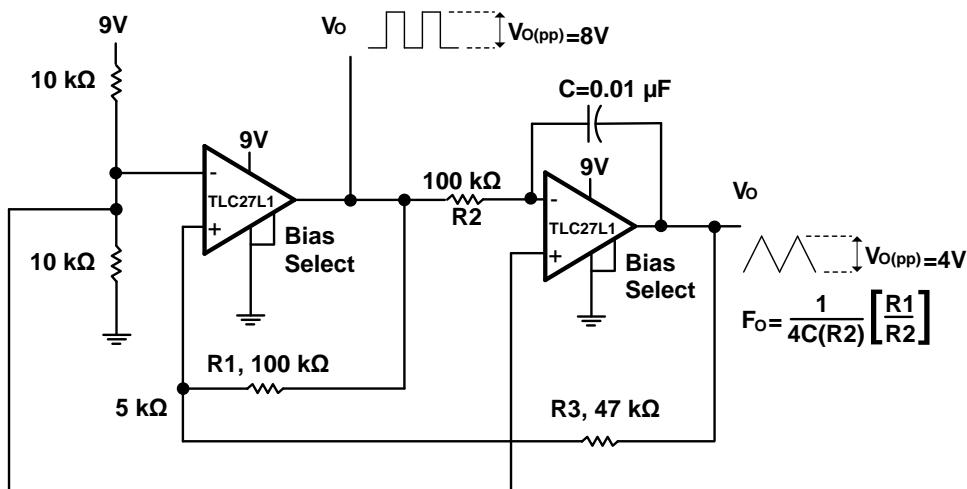


Figure 35 Single Supply Function Generator

**Typical Application Circuits (cont.)**

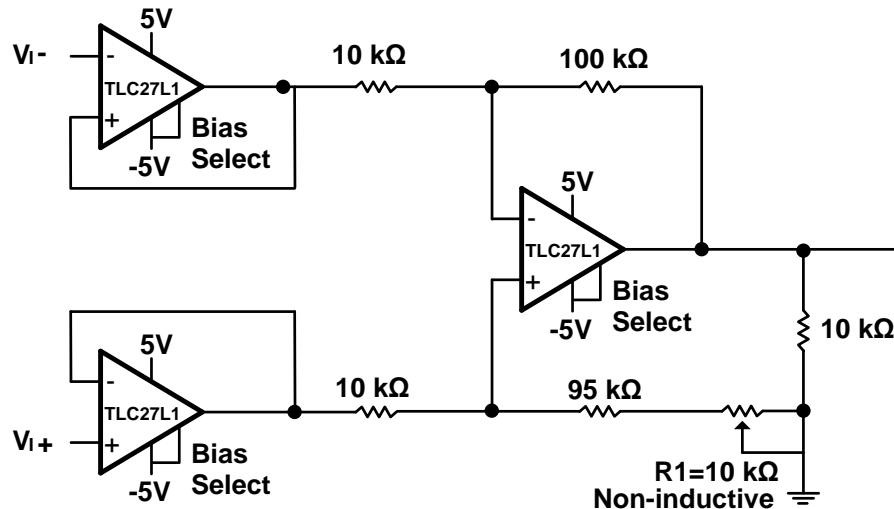


Figure 36 Low Power Instrumentation Amplifier

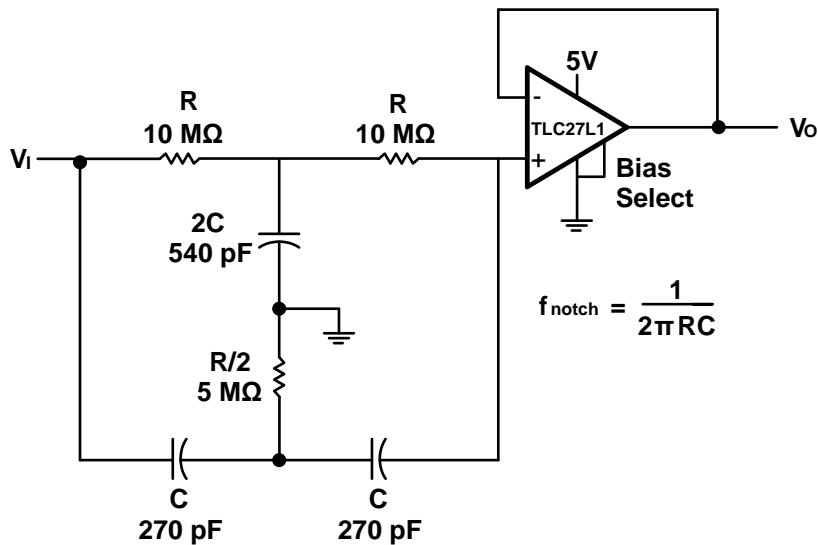


Figure 37 Single Supply Twin-T Notch Filter

**Typical Application Circuits (cont.)**

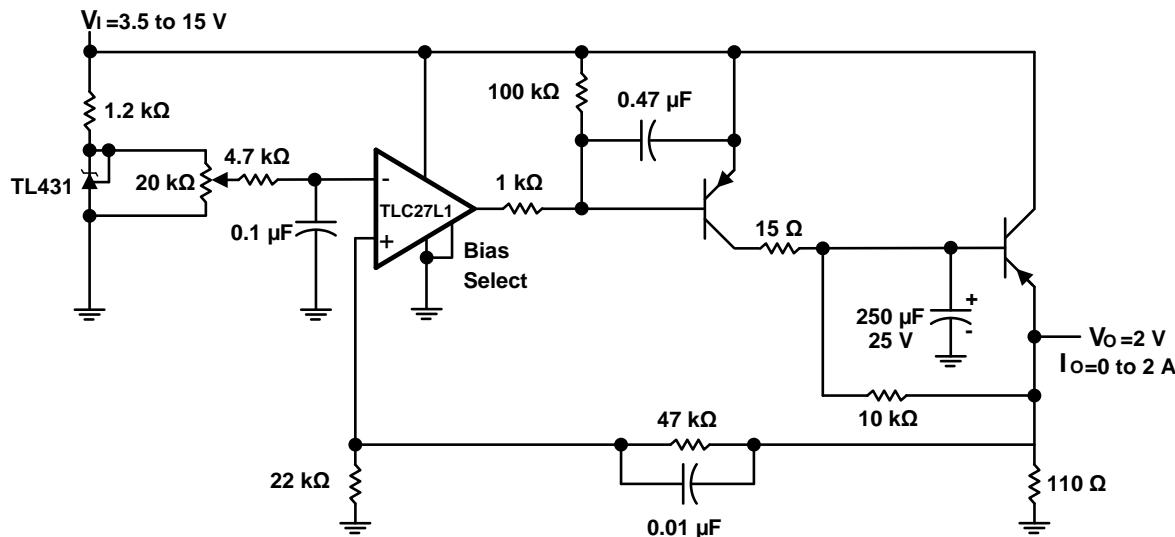


Figure 38 Power Supply

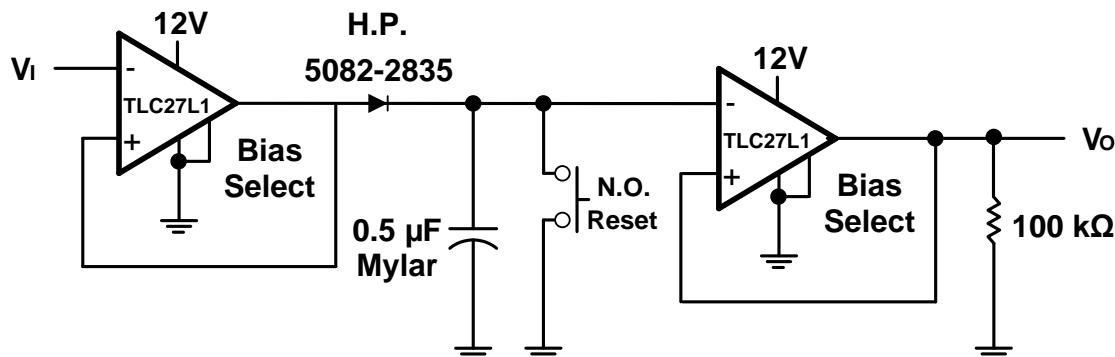


Figure 39 Positive Peak Detector

**Typical Application Circuits (cont.)**

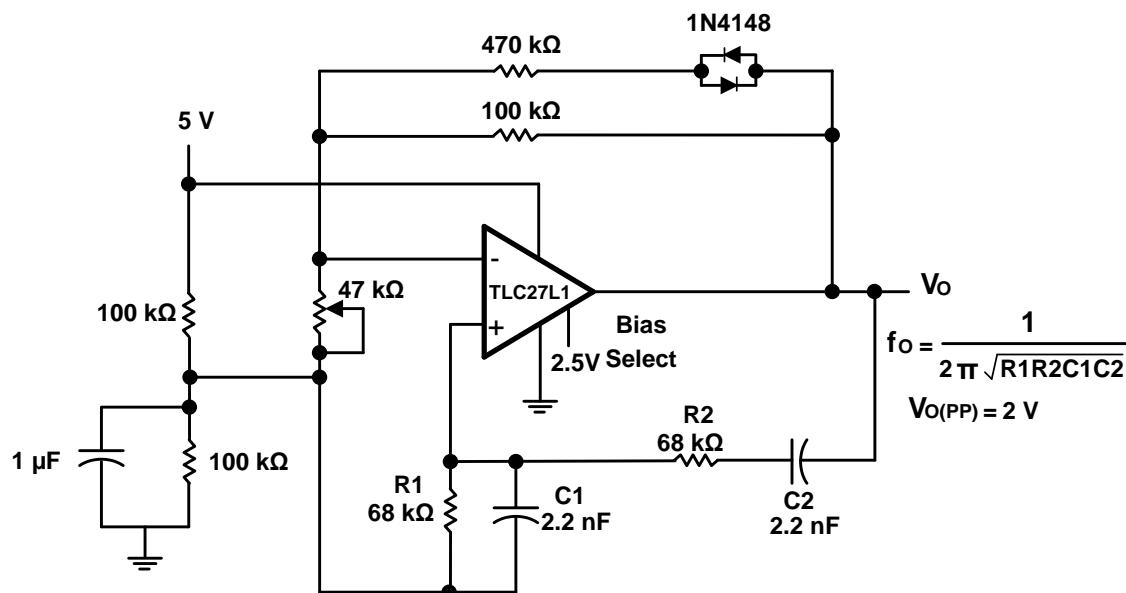


Figure 40 Wein Oscillator

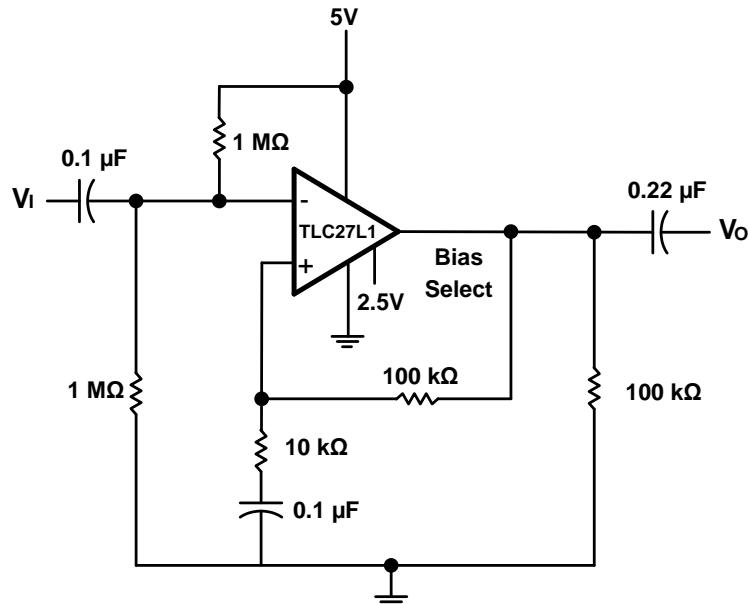
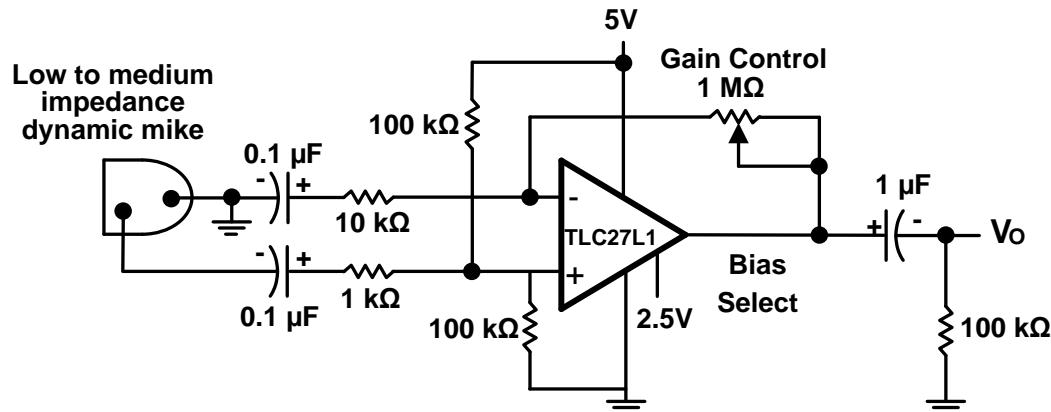
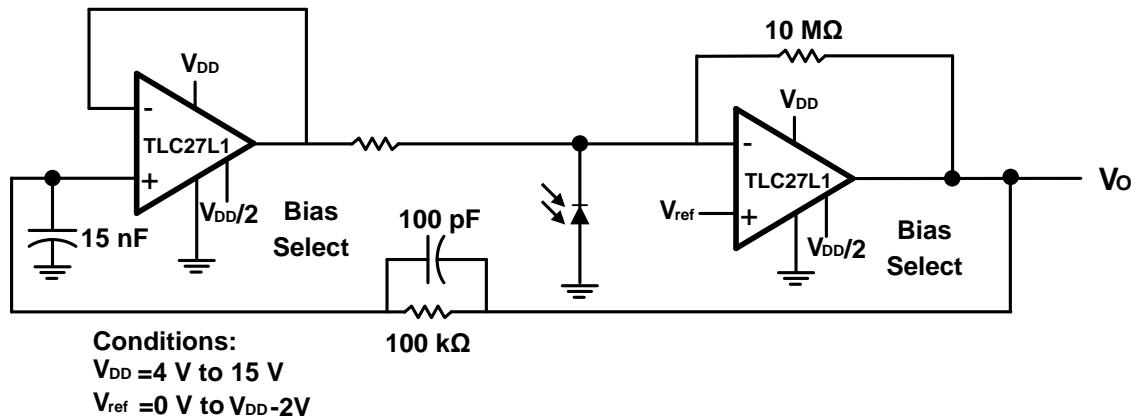


Figure 41 Single-Supply AC Amplifier

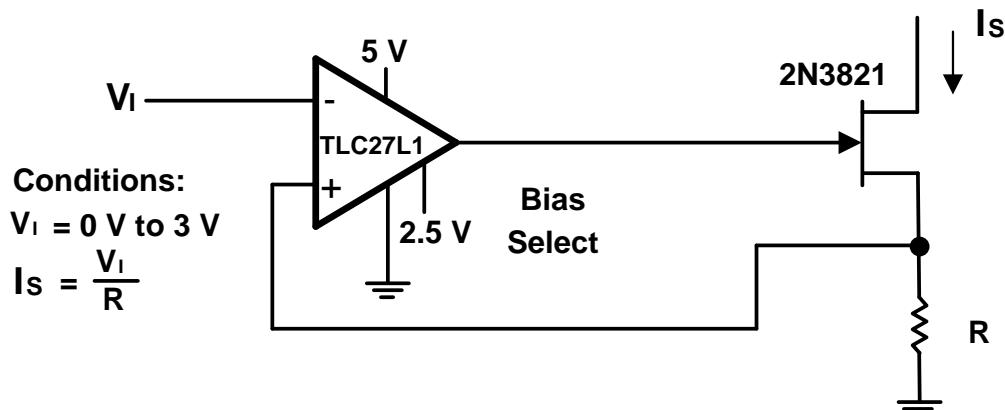
## Typical Application Circuits (cont.)



## Figure 42 Microphone Preamplifier



**Figure 43 Photo-Diode Amplifier With Ambient Light Rejection**



**Figure 44 Precision Low-Current Sink**

**Typical Application Circuits (cont.)**

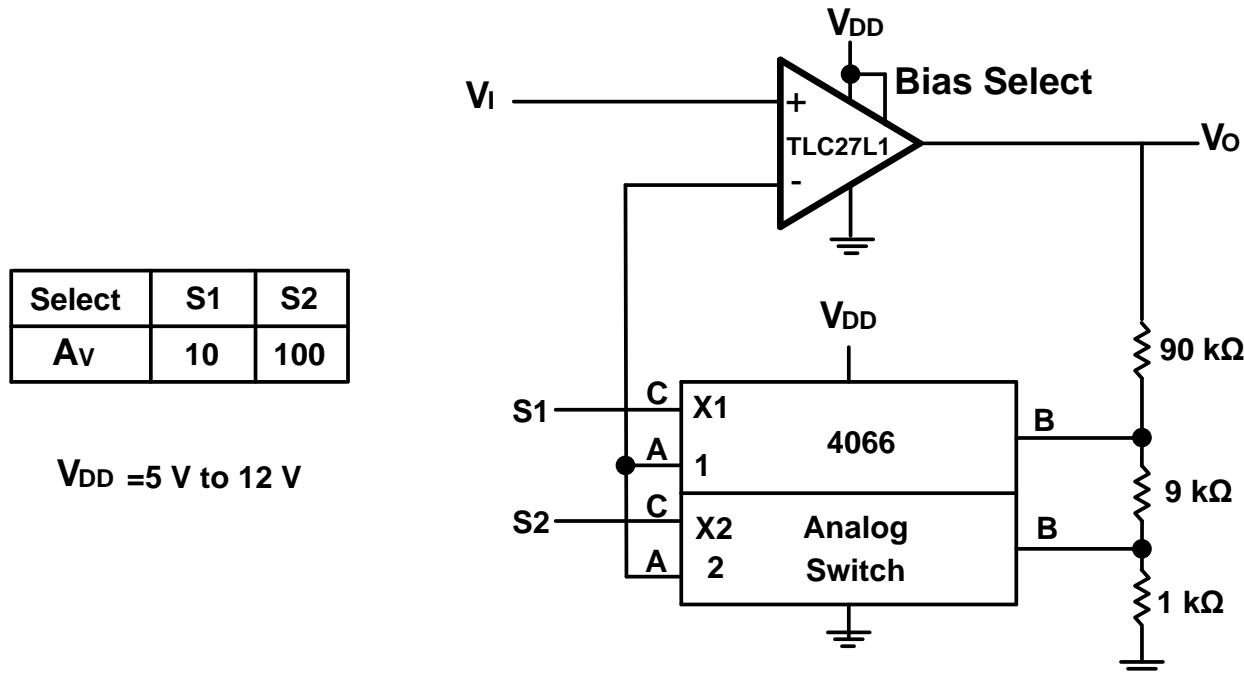


Figure 45 Amplifier With Digital Gain Selection

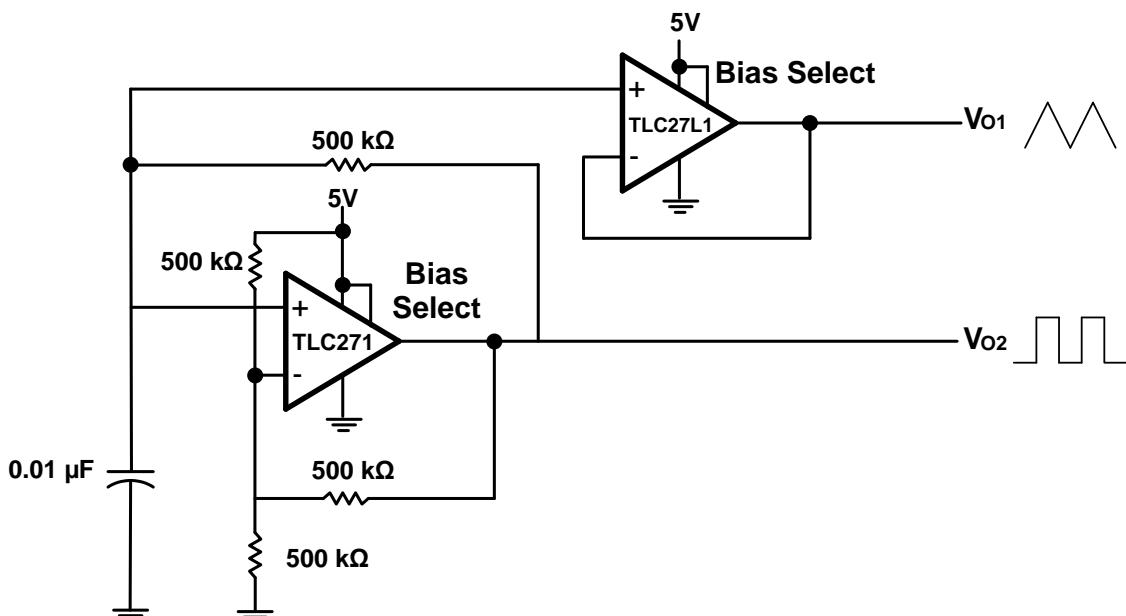


Figure 46 Multivibrator

Typical Application Circuits (cont.)

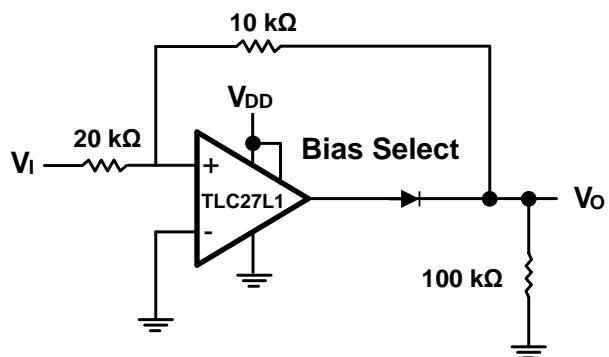
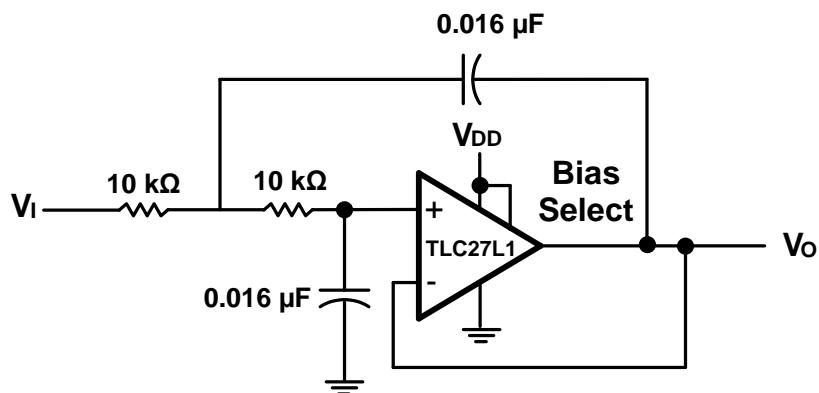


Figure 47 Full Wave Rectifier



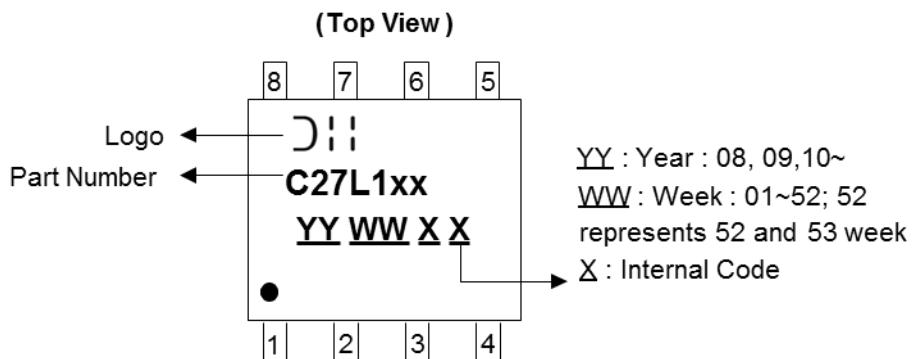
Normalized to  $F_c = 1$  kHz and  $R_L = 10$  kΩ

Figure 48 Two-Pole Low-Pass Butterworth Filter

## Marking Information

SO-8

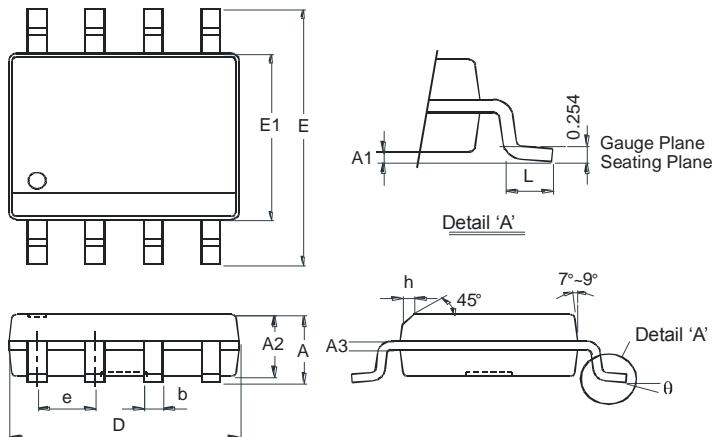
Part mark	Part number
C27L1C	TLC27L1CS
C27L1AC	TLC27L1ACS
C27L1BC	TLC27L1BCS
C27L1I	TLC27L1IS
C27L1AI	TLC27L1AIS
C27L1BI	TLC27L1BIS



## Package Outline Dimensions

Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.

**Package Type: SO-8**



SO-8		
Dim	Min	Max
A	-	1.75
A1	0.10	0.20
A2	1.30	1.50
A3	0.15	0.25
b	0.3	0.5
D	4.85	4.95
E	5.90	6.10
E1	3.85	3.95
e	1.27 Typ	
h	-	0.35
L	0.62	0.82
$\theta$	$0^\circ$	$8^\circ$

All Dimensions in mm

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