

# LM6132,LM6134

*LM6132/LM6134 Dual and Quad Low Power 10 MHz Rail-to-Rail I/O Operational Amplifiers*

# Datasheet.Directory



Literature Number: SNOS751C

# LM6132/LM6134

## Dual and Quad Low Power 10 MHz Rail-to-Rail I/O Operational Amplifiers

### General Description

The LM6132/34 provides new levels of speed vs. power performance in applications where low voltage supplies or power limitations previously made compromise necessary. With only 360  $\mu$ A/amp supply current, the 10 MHz gain-bandwidth of this device supports new portable applications where higher power devices unacceptably drain battery life.

The LM6132/34 can be driven by voltages that exceed both power supply rails, thus eliminating concerns over exceeding the common-mode voltage range. The rail-to-rail output swing capability provides the maximum possible dynamic range at the output. This is particularly important when operating on low supply voltages. The LM6132/34 can also drive large capacitive loads without oscillating.

Operating on supplies from 2.7V to over 24V, the LM6132/34 is excellent for a very wide range of applications, from battery operated systems with large bandwidth requirements to high speed instrumentation.

### Features

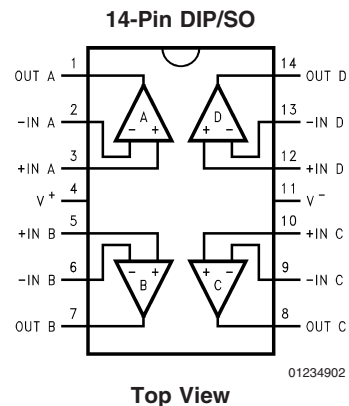
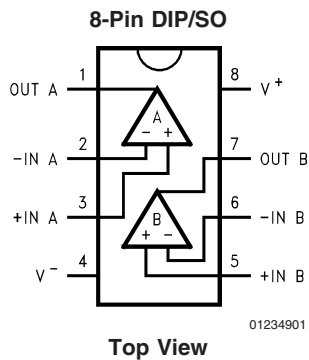
(For 5V Supply, Typ Unless Noted)

- Rail-to-Rail input CMVR  $-0.25V$  to  $5.25V$
- Rail-to-Rail output swing  $0.01V$  to  $4.99V$
- High gain-bandwidth, 10 MHz at 20 kHz
- Slew rate 12 V/ $\mu$ s
- Low supply current 360  $\mu$ A/Amp
- Wide supply range 2.7V to over 24V
- CMRR 100 dB
- Gain 100 dB with  $R_L = 10k$
- PSRR 82 dB

### Applications

- Battery operated instrumentation
- Instrumentation Amplifiers
- Portable scanners
- Wireless communications
- Flat panel display driver

### Connection Diagrams



### Ordering Information

Package	Temperature Range Industrial, $-40^{\circ}C$ to $+85^{\circ}C$	Transport Media	NSC Drawing
8-Pin Molded DIP	LM6132AIN, LM6132BIN	Rails	N08E
8-Pin Small Outline	LM6132AIM, LM6132BIM	Rails	M08A
	LM6132AIMX, LM6132BIMX	Tape and Reel	M08A
14-Pin Molded DIP	LM6134AIN, LM6134BIN	Rails	N14A
14-Pin Small Outline	LM6134AIM, LM6134BIM	Rails	M14A
	LM6134AIMX, LM6134BIMX	Tape and Reel	M14A

**Absolute Maximum Ratings** (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

ESD Tolerance (Note 2)	2500V
Differential Input Voltage	15V
Voltage at Input/Output Pin	(V <sup>+</sup> )+0.3V, (V <sup>-</sup> )-0.3V
Supply Voltage (V <sup>+</sup> -V <sup>-</sup> )	35V
Current at Input Pin	±10 mA
Current at Output Pin (Note 3)	±25 mA
Current at Power Supply Pin	50 mA
Lead Temp. (soldering, 10 sec.)	260°C
Storage Temperature Range	-65°C to +150°C
Junction Temperature (Note 4)	150°C

**Operating Ratings**(Note 1)

Supply Voltage	1.8V ≤ V <sup>+</sup> ≤ 24V
Junction Temperature Range	-40°C ≤ T <sub>J</sub> ≤ +85°C
LM6132, LM6134	
Thermal resistance (θ <sub>JA</sub> )	
N Package, 8-pin Molded DIP	115°C/W
M Package, 8-pin Surface	
Mount	193°C/W
N Package, 14-pin Molded DIP	81°C/W
M Package, 14-pin Surface	
Mount	126°C/W

**5.0V DC Electrical Characteristics**

Unless otherwise specified, all limits guaranteed for T<sub>J</sub> = 25°C, V<sup>+</sup> = 5.0V, V<sup>-</sup> = 0V, V<sub>CM</sub> = V<sub>O</sub> = V<sup>+</sup>/2 and R<sub>L</sub> > 1 MΩ to V<sup>+</sup>/2. **Boldface** limits apply at the temperature extremes

Symbol	Parameter	Conditions	Typ (Note 5)	LM6134AI LM6132AI Limit (Note 6)	LM6134BI LM6132BI Limit (Note 6)	Units
V <sub>OS</sub>	Input Offset Voltage		0.25	2 4	6 8	mV max
TCV <sub>OS</sub>	Input Offset Voltage Average Drift		5			μV/C
I <sub>B</sub>	Input Bias Current	0V ≤ V <sub>CM</sub> ≤ 5V	110	140 300	180 350	nA max
I <sub>OS</sub>	Input Offset Current		3.4	30 50	30 50	nA max
R <sub>IN</sub>	Input Resistance, CM		104			MΩ
CMRR	Common Mode Rejection Ratio	0V ≤ V <sub>CM</sub> ≤ 4V	100	75 70	75 70	dB min
		0V ≤ V <sub>CM</sub> ≤ 5V	80	60 55	60 55	
PSRR	Power Supply Rejection Ratio	±2.5V ≤ V <sup>+</sup> ≤ ±12V	82	78 75	78 75	dB min
V <sub>CM</sub>	Input Common-Mode Voltage Range		-0.25	0	0	V
			5.25	5.0	5.0	
A <sub>V</sub>	Large Signal Voltage Gain	R <sub>L</sub> = 10k	100	25 8	15 6	V/mV min
V <sub>O</sub>	Output Swing	100k Load	4.992	4.98 4.93	4.98 4.93	V min
			0.007	0.017 0.019	0.017 0.019	V max
		10k Load	4.952	4.94 4.85	4.94 4.85	V min
			0.032	0.07 0.09	0.07 0.09	V max
		5k Load	4.923	4.90 4.85	4.90 4.85	V min
			0.051	0.095 0.12	0.095 0.12	V max

## 5.0V DC Electrical Characteristics (Continued)

Unless otherwise specified, all limits guaranteed for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 5.0\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V_O = V^+/2$  and  $R_L > 1\text{M}\Omega$  to  $V^+/2$ .

**Boldface** limits apply at the temperature extremes

Symbol	Parameter	Conditions	Typ (Note 5)	LM6134AI LM6132AI Limit (Note 6)	LM6134BI LM6132BI Limit (Note 6)	Units
$I_{\text{SC}}$	Output Short Circuit Current LM6132	Sourcing	4	2 <b>2</b>	2 <b>1</b>	mA min
		Sinking	3.5	1.8 <b>1.8</b>	1.8 <b>1</b>	mA min
$I_{\text{SC}}$	Output Short Circuit Current LM6134	Sourcing	3	2 <b>1.6</b>	2 <b>1</b>	mA min
		Sinking	3.5	1.8 <b>1.3</b>	1.8 <b>1</b>	mA min
$I_{\text{S}}$	Supply Current	Per Amplifier	360	400 <b>450</b>	400 <b>450</b>	$\mu\text{A}$ max

## 5.0V AC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 5.0\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V_O = V^+/2$  and  $R_L > 1\text{M}\Omega$  to  $V^+/2$ .

**Boldface** limits apply at the temperature extremes

Symbol	Parameter	Conditions	Typ (Note 5)	LM6134AI LM6132AI Limit (Note 6)	LM6134BI LM6132BI Limit (Note 6)	Units
SR	Slew Rate	$\pm 4\text{V}$ @ $V_{\text{S}} = \pm 6\text{V}$ $R_{\text{S}} < 1\text{k}\Omega$	14	8 <b>7</b>	8 <b>7</b>	$\text{V}/\mu\text{s}$ min
GBW	Gain-Bandwidth Product	$f = 20\text{kHz}$	10	7.4 <b>7</b>	7.4 <b>7</b>	MHz min
$\theta_{\text{m}}$	Phase Margin	$R_L = 10\text{k}$	33			deg
$G_{\text{m}}$	Gain Margin	$R_L = 10\text{k}$	10			dB
$e_{\text{n}}$	Input Referred Voltage Noise	$f = 1\text{kHz}$	27			$\frac{\text{nV}}{\sqrt{\text{Hz}}}$
$i_{\text{n}}$	Input Referred Current Noise	$f = 1\text{kHz}$	0.18			$\frac{\text{pA}}{\sqrt{\text{Hz}}}$

## 2.7V DC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 2.7\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V_O = V^+/2$  and  $R_L > 1\text{M}\Omega$  to  $V^+/2$ .

**Boldface** limits apply at the temperature extreme

Symbol	Parameter	Conditions	Typ (Note 5)	LM6134AI LM6132AI Limit (Note 6)	LM6134BI LM6132BI Limit (Note 6)	Units
$V_{\text{OS}}$	Input Offset Voltage		0.12	2 <b>8</b>	6 <b>12</b>	mV max
$I_{\text{B}}$	Input Bias Current	$0\text{V} \leq V_{\text{CM}} \leq 2.7\text{V}$	90			nA
$I_{\text{OS}}$	Input Offset Current		2.8			nA
$R_{\text{IN}}$	Input Resistance		134			$\text{M}\Omega$
CMRR	Common Mode Rejection Ratio	$0\text{V} \leq V_{\text{CM}} \leq 2.7\text{V}$	82			dB
PSRR	Power Supply	$\pm 1.35\text{V} \leq V^+ \leq \pm 12\text{V}$	80			dB

## 2.7V DC Electrical Characteristics (Continued)

Unless otherwise specified, all limits guaranteed for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 2.7\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V_O = V^+/2$  and  $R_L > 1\text{ M}\Omega$  to  $V^+/2$ .

**Boldface** limits apply at the temperature extreme

Symbol	Parameter	Conditions	Typ (Note 5)	LM6134AI LM6132AI Limit (Note 6)	LM6134BI LM6132BI Limit (Note 6)	Units
	Rejection Ratio					
$V_{\text{CM}}$	Input Common-Mode Voltage Range			2.7	2.7	V
				0	0	
$A_V$	Large Signal Voltage Gain	$R_L = 10\text{k}$	100			V/mV
$V_O$	Output Swing	$R_L = 100\text{k}$	0.03	0.08	0.08	V
				<b>0.112</b>	<b>0.112</b>	max
			2.66	2.65	2.65	V
				<b>2.25</b>	<b>2.25</b>	min
$I_S$	Supply Current	Per Amplifier	330			$\mu\text{A}$

## 2.7V AC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 2.7\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V_O = V^+/2$  and  $R_L > 1\text{ M}\Omega$  to  $V^+/2$ .

Symbol	Parameter	Conditions	Typ (Note 5)	LM6134AI LM6132AI Limit (Note 6)	LM6134BI LM6132BI Limit (Note 6)	Units
GBW	Gain-Bandwidth Product	$R_L = 10\text{k}$ , $f = 20\text{ kHz}$	7			MHz
$\theta_m$	Phase Margin	$R_L = 10\text{k}$	23			deg
$G_m$	Gain Margin		12			dB

## 24V DC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 24\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V_O = V^+/2$  and  $R_L > 1\text{ M}\Omega$  to  $V^+/2$ . **Boldface** limits apply at the temperature extreme

Symbol	Parameter	Conditions	Typ (Note 5)	LM6134AI LM6132AI Limit (Note 6)	LM6134BI LM6132BI Limit (Note 6)	Units
$V_{\text{OS}}$	Input Offset Voltage		1.7	3 <b>5</b>	7 <b>9</b>	mV max
$I_{\text{B}}$	Input Bias Current	$0\text{V} \leq V_{\text{CM}} \leq 24\text{V}$	125			nA
$I_{\text{OS}}$	Input Offset Current		4.8			nA
$R_{\text{IN}}$	Input Resistance		210			$\text{M}\Omega$
CMRR	Common Mode Rejection Ratio	$0\text{V} \leq V_{\text{CM}} \leq 24\text{V}$	80			dB
PSRR	Power Supply Rejection Ratio	$2.7\text{V} \leq V^+ \leq 24\text{V}$	82			dB
$V_{\text{CM}}$	Input Common-Mode Voltage Range		-0.25	0	0	V min
			24.25	24	24	V max
$A_{\text{V}}$	Large Signal Voltage Gain	$R_L = 10\text{k}$	102			V/mV
$V_{\text{O}}$	Output Swing	$R_L = 10\text{k}$	0.075	0.15	0.15	V max
			23.86	23.8	23.8	V min
$I_{\text{S}}$	Supply Current	Per Amplifier	390	450 <b>490</b>	450 <b>490</b>	$\mu\text{A}$ max

## 24V AC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for  $T_J = 25^\circ\text{C}$ ,  $V^+ = 24\text{V}$ ,  $V^- = 0\text{V}$ ,  $V_{\text{CM}} = V_O = V^+/2$  and  $R_L > 1\text{ M}\Omega$  to  $V^+/2$ .

Symbol	Parameter	Conditions	Typ (Note 5)	LM6134AI LM6132AI Limit (Note 6)	LM6134BI LM6132BI Limit (Note 6)	Units
GBW	Gain-Bandwidth Product	$R_L = 10\text{k}$ , $f = 20\text{ kHz}$	11			MHz
$\theta_m$	Phase Margin	$R_L = 10\text{k}$	23			deg
$G_m$	Gain Margin	$R_L = 10\text{k}$	12			dB
THD + N	Total Harmonic Distortion and Noise	$A_{\text{V}} = +1$ , $V_{\text{O}} = 20\text{V}_{\text{P-P}}$ $f = 10\text{ kHz}$	0.0015			%

**Note 1:** Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical characteristics.

**Note 2:** Human body model, 1.5 k $\Omega$  in series with 100 pF.

**Note 3:** Applies to both single-supply and split-supply operation. Continuous short circuit operation at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150°C.

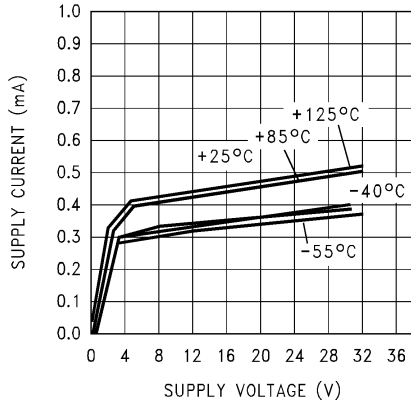
**Note 4:** The maximum power dissipation is a function of  $T_{\text{J(MAX)}}$ ,  $\theta_{\text{JA}}$ , and  $T_{\text{A}}$ . The maximum allowable power dissipation at any ambient temperature is  $P_{\text{D}} = (T_{\text{J(MAX)}} - T_{\text{A}})/\theta_{\text{JA}}$ . All numbers apply for packages soldered directly into a PC board.

**Note 5:** Typical Values represent the most likely parametric norm.

**Note 6:** All limits are guaranteed by testing or statistical analysis.

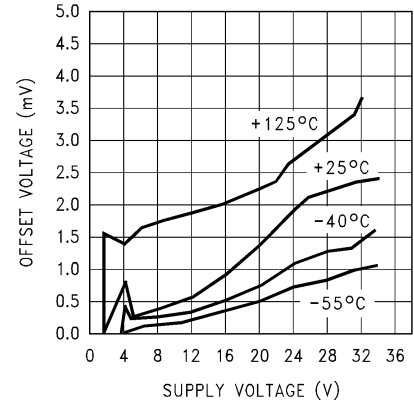
**Typical Performance Characteristics**  $T_A = 25^\circ\text{C}$ ,  $R_L = 10\text{ k}\Omega$  unless otherwise specified

**Supply Current vs. Supply Voltage**



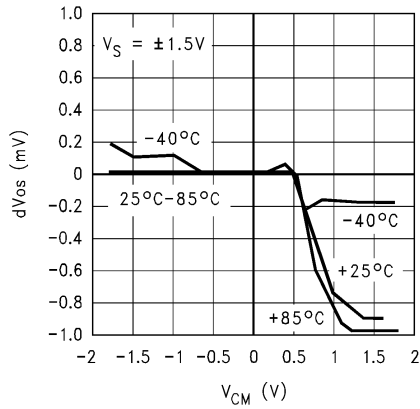
01234903

**Offset Voltage vs. Supply Voltage**



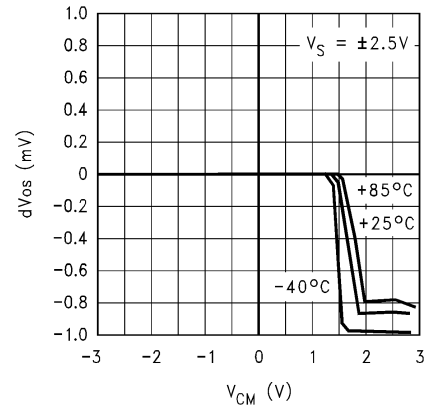
01234905

**dV<sub>OS</sub> vs. V<sub>CM</sub>**



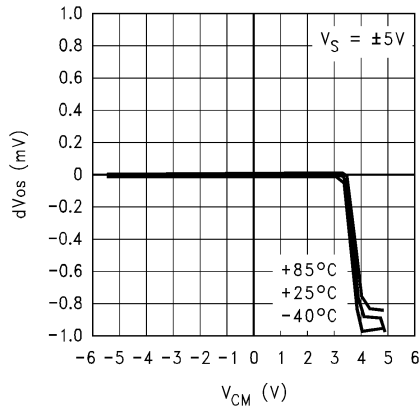
01234906

**dV<sub>OS</sub> vs. V<sub>CM</sub>**



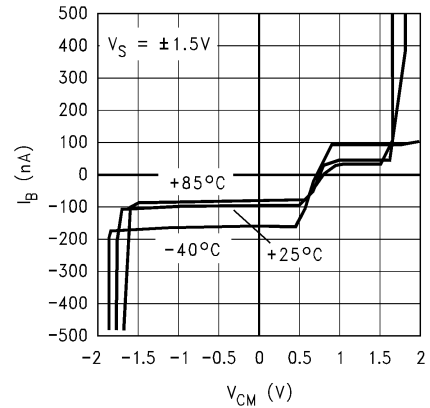
01234907

**dV<sub>OS</sub> vs. V<sub>CM</sub>**



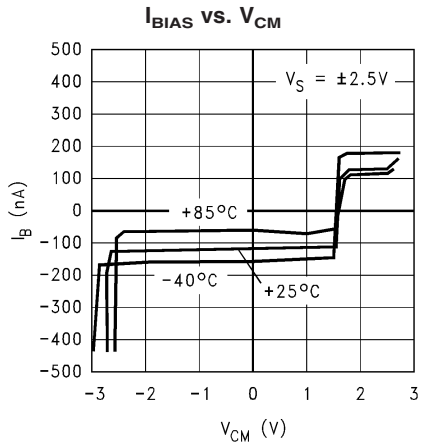
01234908

**I<sub>BIAS</sub> vs. V<sub>CM</sub>**

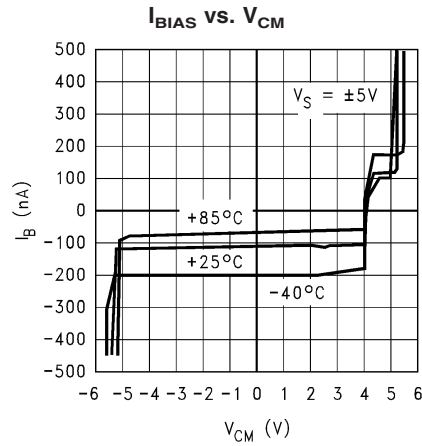


01234909

**Typical Performance Characteristics**  $T_A = 25^\circ\text{C}$ ,  $R_L = 10\text{ k}\Omega$  unless otherwise specified (Continued)

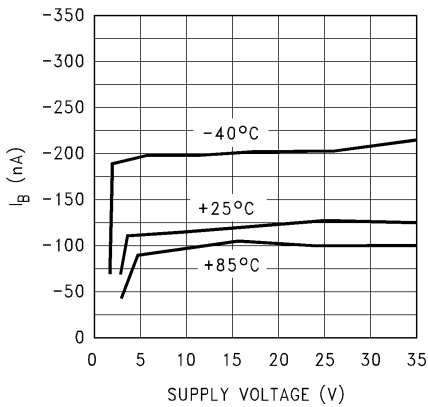


01234910



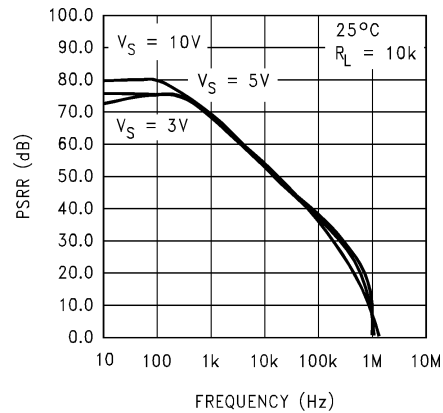
01234911

**Input Bias Current vs. Supply Voltage**



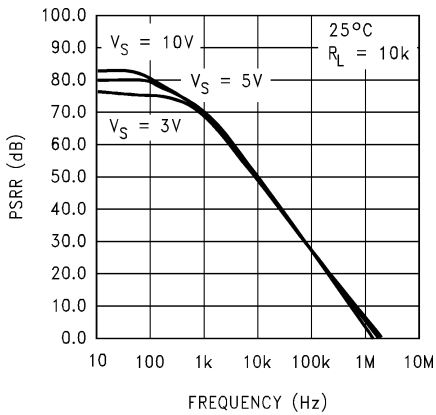
01234912

**Negative PSRR vs. Frequency**



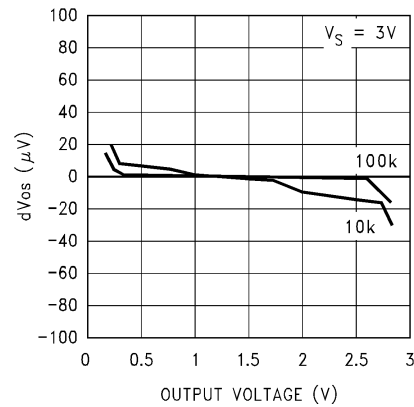
01234913

**Positive PSRR vs. Frequency**



01234914

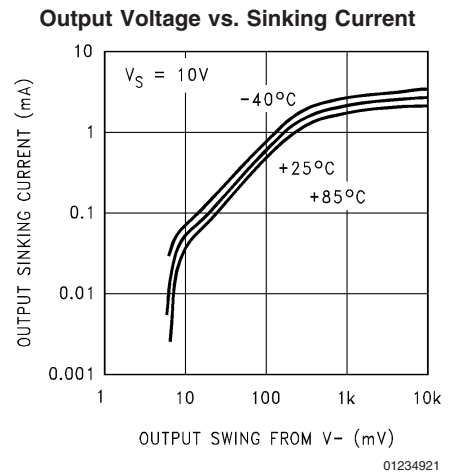
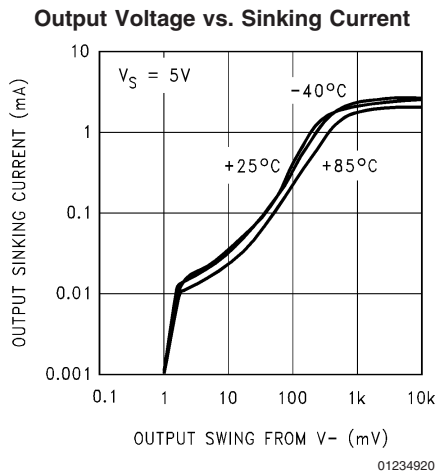
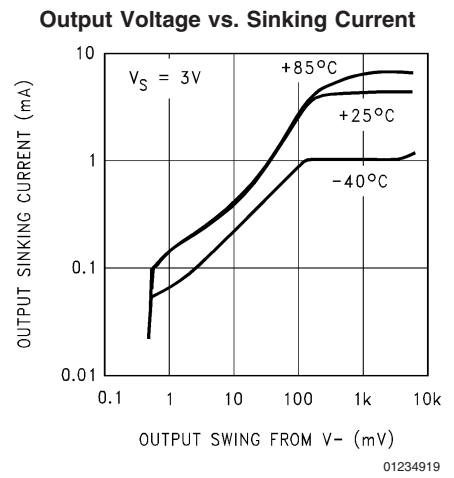
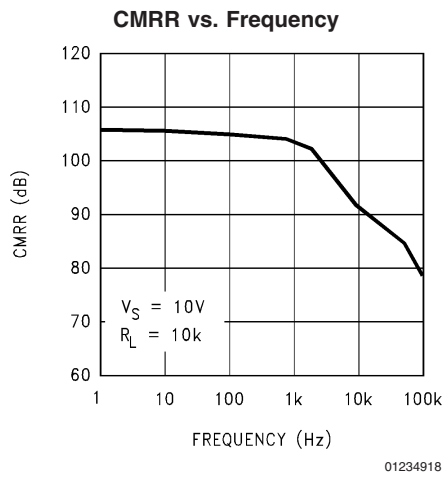
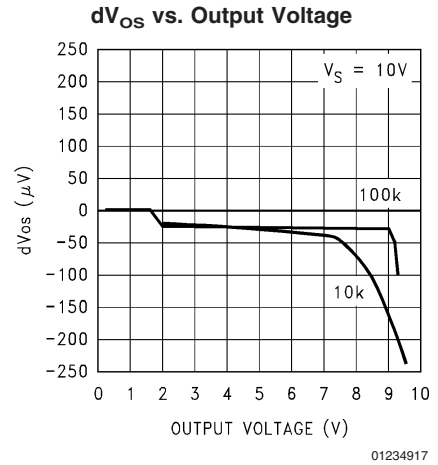
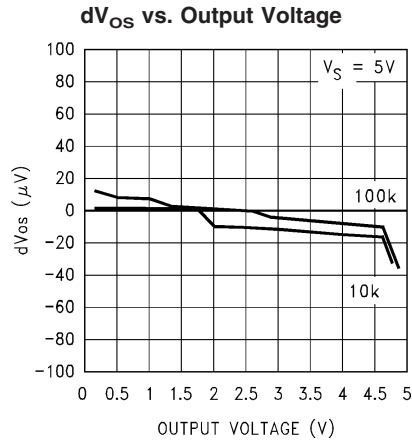
**$dV_{OS}$  vs. Output Voltage**



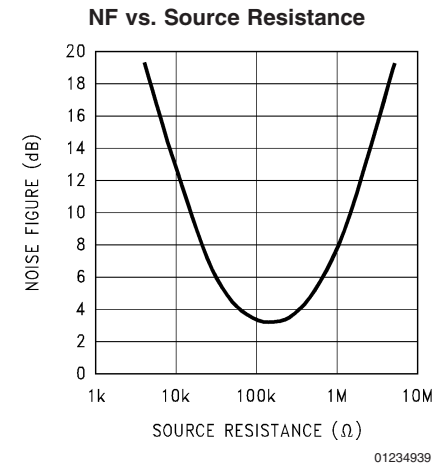
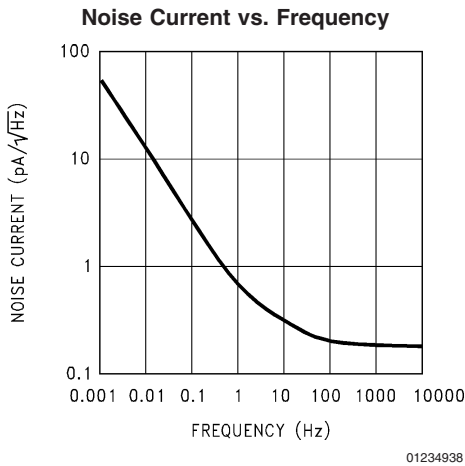
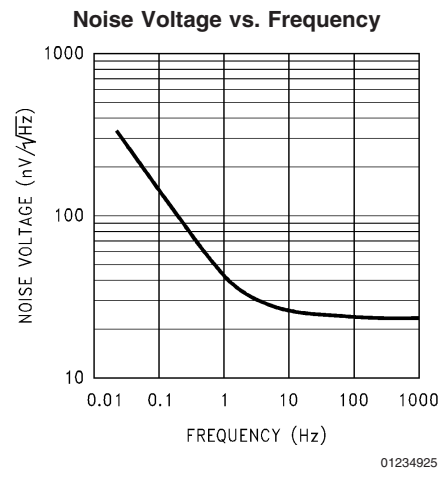
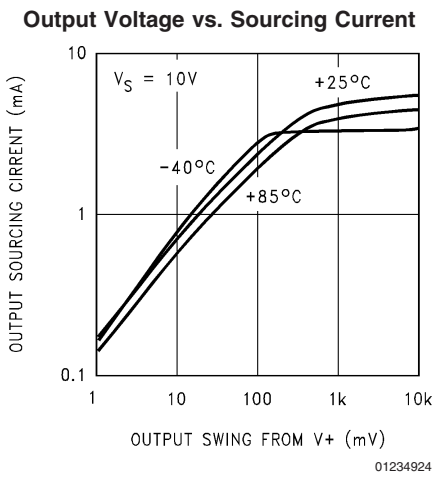
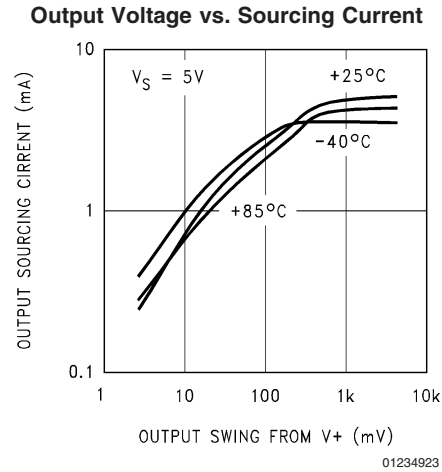
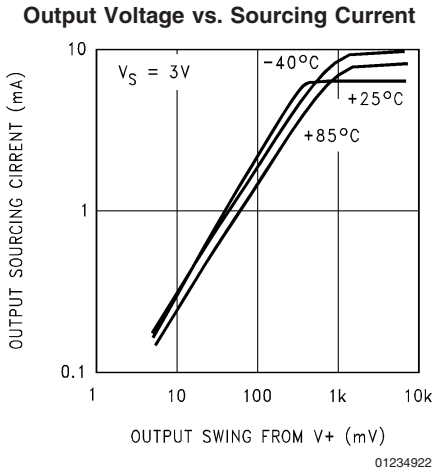
01234915



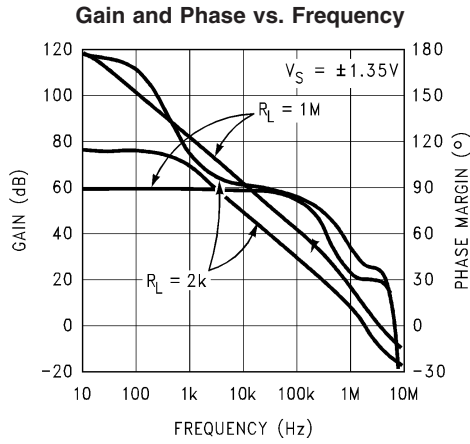
**Typical Performance Characteristics**  $T_A = 25^\circ\text{C}$ ,  $R_L = 10\text{ k}\Omega$  unless otherwise specified (Continued)



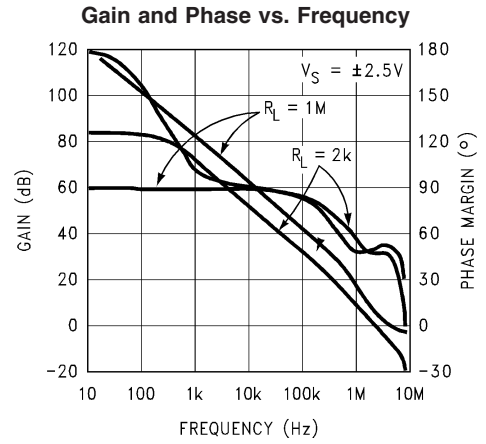
**Typical Performance Characteristics**  $T_A = 25^\circ\text{C}$ ,  $R_L = 10\text{ k}\Omega$  unless otherwise specified (Continued)



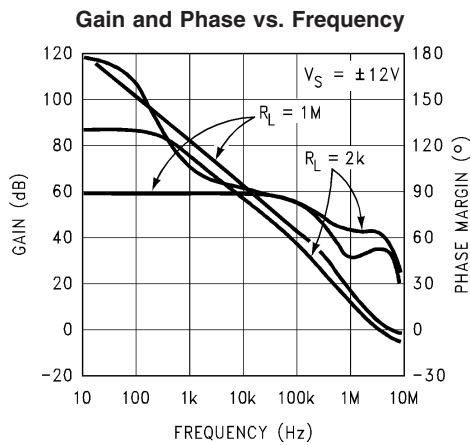
**Typical Performance Characteristics**  $T_A = 25^\circ\text{C}$ ,  $R_L = 10\text{ k}\Omega$  unless otherwise specified (Continued)



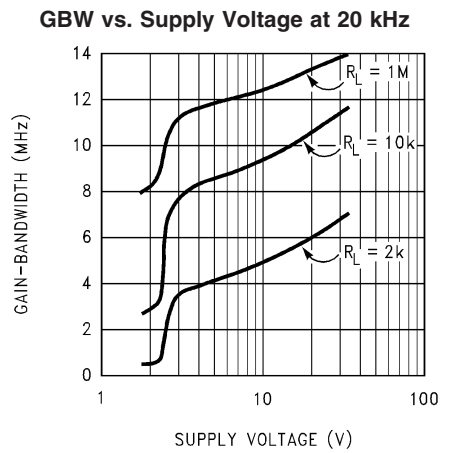
01234928



01234929



01234930



01234931

## LM6132/34 Application Information

The LM6132 brings a new level of ease of use to op amp system design.

With greater than rail-to-rail input voltage range concern over exceeding the common-mode voltage range is eliminated.

Rail-to-rail output swing provides the maximum possible dynamic range at the output. This is particularly important when operating on low supply voltages.

The high gain-bandwidth with low supply current opens new battery powered applications, where high power consumption, previously reduced battery life to unacceptable levels.

To take advantage of these features, some ideas should be kept in mind.

### ENHANCED SLEW RATE

Unlike most bipolar op amps, the unique phase reversal prevention/speed-up circuit in the input stage eliminates phase reversal and allows the slew rate to be very much a function of the input signal amplitude.

Figure 2 shows how excess input signal is routed around the input collector-base junctions directly to the current mirrors.

The LM6132/34 input stage converts the input voltage change to a current change. This current change drives the current mirrors through the collectors of Q1–Q2, Q3–Q4 when the input levels are normal.

If the input signal exceeds the slew rate of the input stage and the differential input voltage rises above a diode drop, the excess signal bypasses the normal input transistors, (Q1–Q4), and is routed in correct phase through the two additional transistors, (Q5, Q6), directly into the current mirrors.

This rerouting of excess signal allows the slew-rate to increase by a factor of 10 to 1 or more. (See Figure 1.)

As the overdrive increases, the op amp reacts better than a conventional op amp. Large fast pulses will raise the slew-rate to around 25V to 30 V/ $\mu$ s.

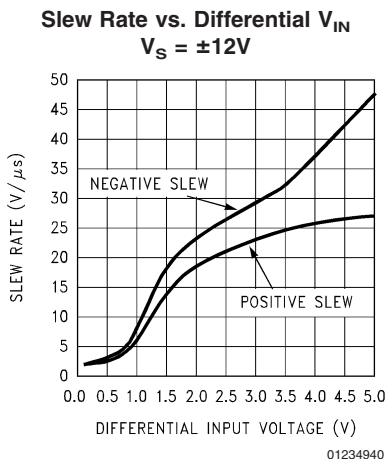


FIGURE 1.

This effect is most noticeable at higher supply voltages and lower gains where incoming signals are likely to be large.

This speed-up action adds stability to the system when driving large capacitive loads.

### DRIVING CAPACITIVE LOADS

Capacitive loads decrease the phase margin of all op amps. This is caused by the output resistance of the amplifier and the load capacitance forming an R-C phase lag network. This can lead to overshoot, ringing and oscillation. Slew rate limiting can also cause additional lag. Most op amps with a fixed maximum slew-rate will lag further and further behind when driving capacitive loads even though the differential input voltage raises. With the LM6132, the lag causes the slew rate to raise. The increased slew-rate keeps the output following the input much better. This effectively reduces phase lag. After the output has caught up with the input, the differential input voltage drops down and the amplifier settles rapidly.

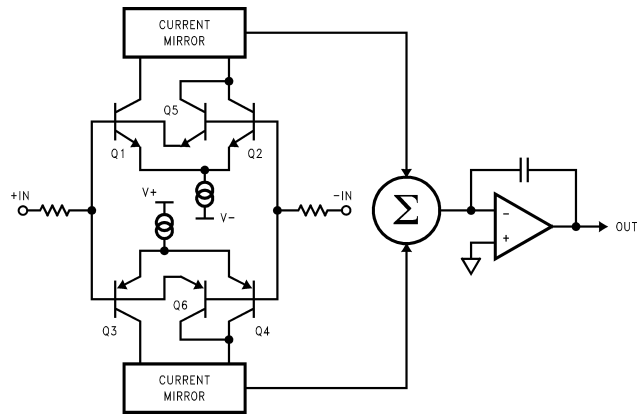


FIGURE 2.

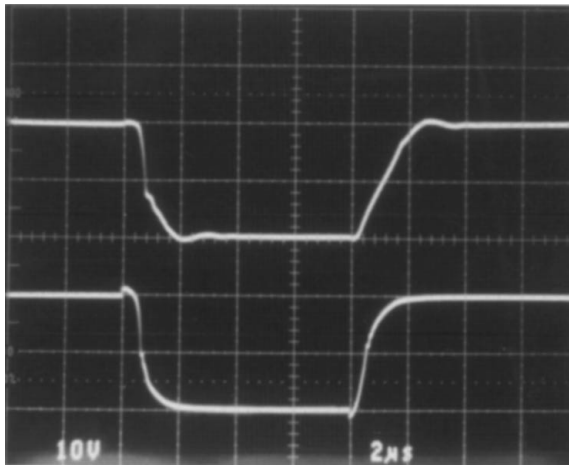
These features allow the LM6132 to drive capacitive loads as large as 500 pF at unity gain and not oscillate. The scope photos (Figure 3 and Figure 4) above show the LM6132 driving a 500 pF load. In Figure 3, the lower trace is with no capacitive load and the upper trace is with a 500 pF load. Here we are operating on  $\pm 12V$  supplies with a 20  $V_{PP}$  pulse. Excellent response is obtained with a  $C_f$  of 39 pF. In Figure 4, the supplies have been reduced to  $\pm 2.5V$ , the pulse is 4  $V_{PP}$  and  $C_f$  is 39 pF. The best value for the compensation capacitor should be established after the board layout is finished because the value is dependent on board stray capacity, the value of the feedback resistor, the closed loop gain and, to some extent, the supply voltage.

Another effect that is common to all op amps is the phase shift caused by the feedback resistor and the input capacitance. This phase shift also reduces phase margin. This effect is taken care of at the same time as the effect of the capacitive load when the capacitor is placed across the feedback resistor.

The circuit shown in Figure 5 was used for these scope photos.

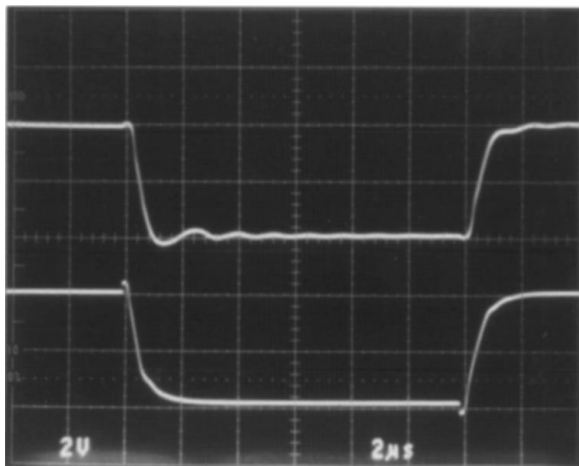
# LM6132/34 Application Information

(Continued)



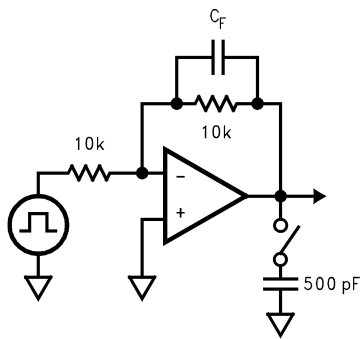
01234945

FIGURE 3.



01234942

FIGURE 4.

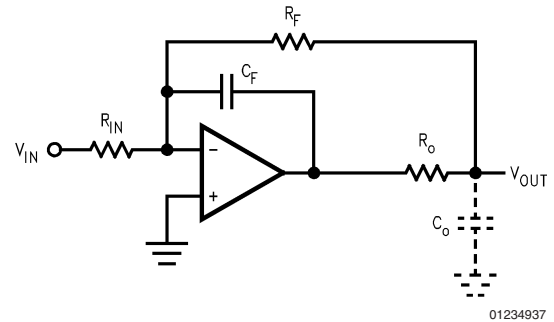


01234943

FIGURE 5.

Figure 6 shows a method for compensating for load capacitance ( $C_O$ ) effects by adding both an isolation resistor  $R_O$  at

the output and a feedback capacitor  $C_F$  directly between the output and the inverting input pin. Feedback capacitor  $C_F$  compensates for the pole introduced by  $R_O$  and  $C_O$ , minimizing ringing in the output waveform while the feedback resistor  $R_F$  compensates for dc inaccuracies introduced by  $R_O$ . Depending on the size of the load capacitance, the value of  $R_O$  is typically chosen to be between  $100\Omega$  to  $1\text{ k}\Omega$ .



01234937

FIGURE 6.

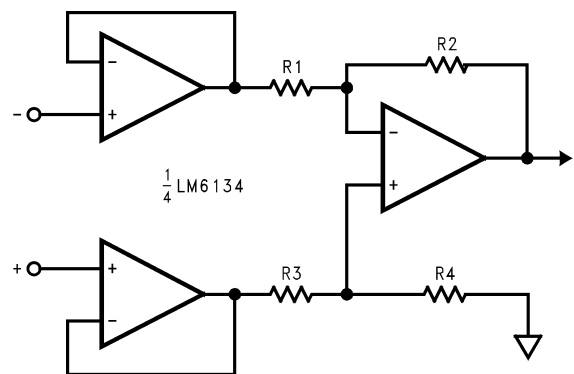
## Typical Applications

### 3 OP AMP INSTRUMENTATION AMP WITH RAIL-TO-RAIL INPUT AND OUTPUT

Using the LM6134, a 3 op amp instrumentation amplifier with rail-to-rail inputs and rail to rail output can be made. These features make these instrumentation amplifiers ideal for single supply systems.

Some manufacturers use a precision voltage divider array of 5 resistors to divide the common-mode voltage to get an input range of rail-to-rail or greater. The problem with this method is that it also divides the signal, so to even get unity gain, the amplifier must be run at high closed loop gains. This raises the noise and drift by the internal gain factor and lowers the input impedance. Any mismatch in these precision resistors reduces the CMR as well. Using the LM6134, all of these problems are eliminated.

In this example, amplifiers A and B act as buffers to the differential stage (Figure 7). These buffers assure that the input impedance is over  $100\text{ M}\Omega$  and they eliminate the requirement for precision matched resistors in the input stage. They also assure that the difference amp is driven from a voltage source. This is necessary to maintain the CMR set by the matching of  $R1-R2$  with  $R3-R4$ .



01234944

FIGURE 7.

## Typical Applications (Continued)

### FLAT PANEL DISPLAY BUFFERING

Three features of the LM6132/34 make it a superb choice for TFT LCD applications. First, its low current draw (360  $\mu$ A per amplifier @ 5V) makes it an ideal choice for battery powered applications such as in laptop computers. Second, since the device operates down to 2.7V, it is a natural choice for next generation 3V TFT panels. Last, but not least, the large capacitive drive capability of the LM6132 comes in very handy in driving highly capacitive loads that are characteristic of LCD display drivers.

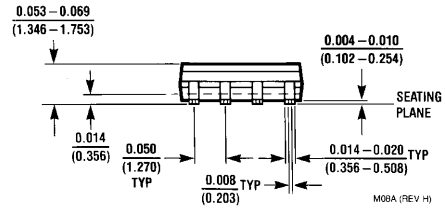
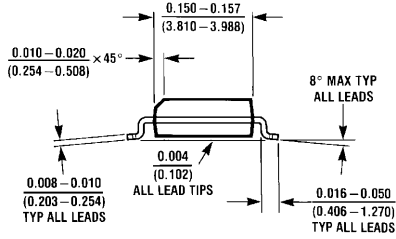
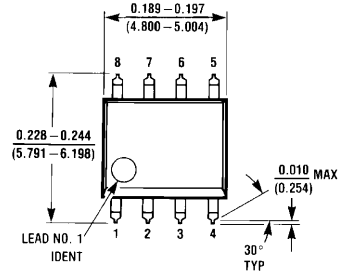
The large capacitive drive capability of the LM6132/34 allows it to be used as buffers for the gamma correction reference voltage inputs of resistor-DAC type column (Source) drivers in TFT LCD panels. This amplifier is also

useful for buffering only the center reference voltage input of Capacitor-DAC type column (Source) drivers such as the LMC750X series.

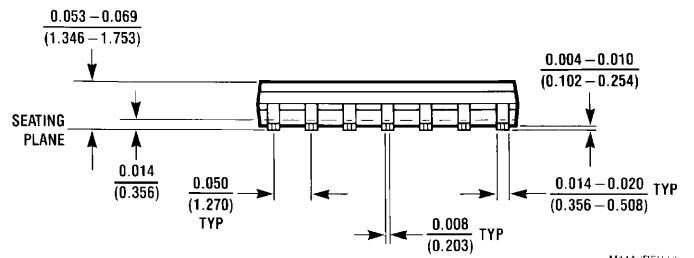
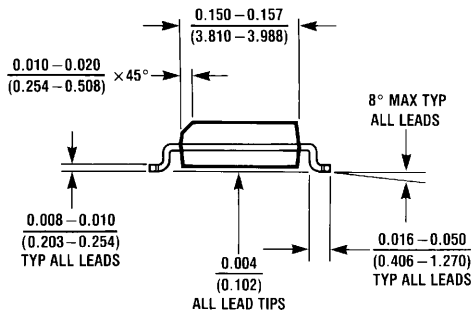
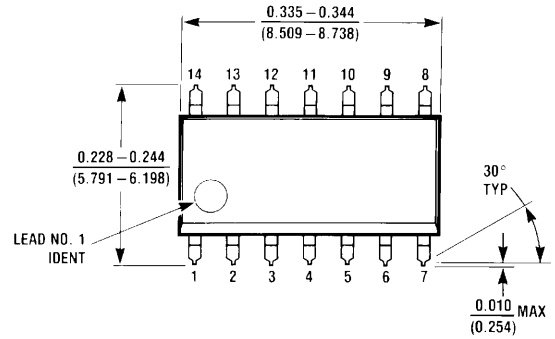
Since for VGA and SVGA displays, the buffered voltages must settle within approximately 4  $\mu$ s, the well known technique of using a small isolation resistor in series with the amplifier's output very effectively dampens the ringing at the output.

With its wide supply voltage range of 2.7V to 24V, the LM6132/34 can be used for a diverse range of applications. The system designer is thus able to choose a single device type that serves many sub-circuits in the system, eliminating the need to specify multiple devices in the bill of materials. Along with its sister parts, the LM6142 and LM6152 that have the same wide supply voltage capability, choice of the LM6132 in a design eliminates the need to search for multiple sources for new designs.

**Physical Dimensions** inches (millimeters)  
 unless otherwise noted

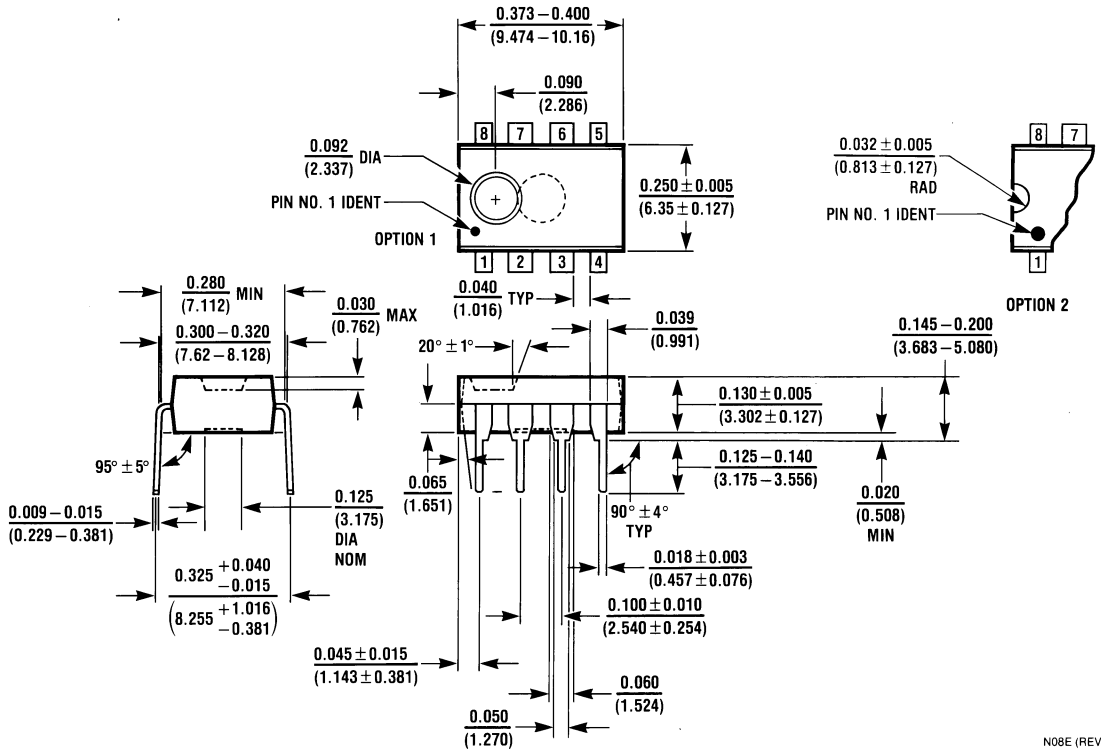


**8-Lead (0.150" Wide) Molded Small Outline Package, JEDEC  
 NS Package Number M08A**



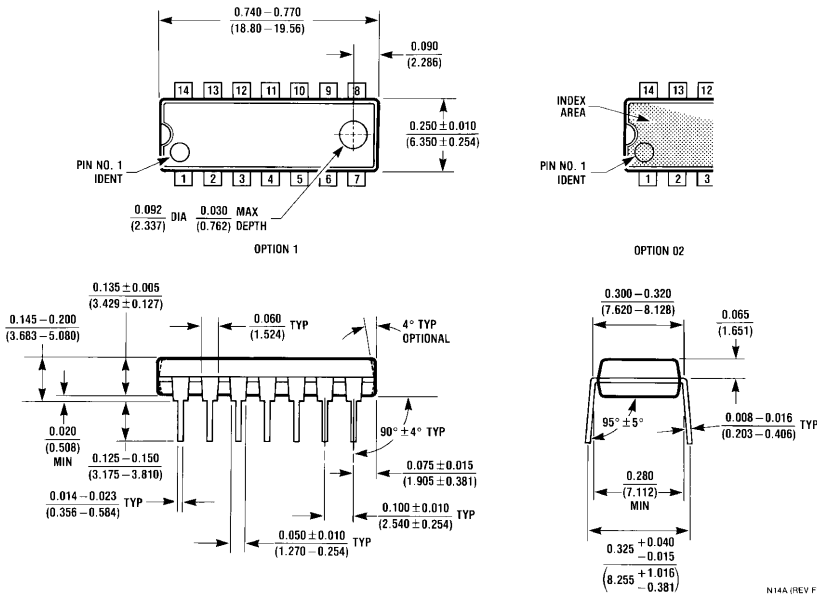
**14-Lead (0.300" Wide) Molded Small Outline Package, JEDEC  
 NS Package Number M14A**

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**8-Lead (0.300" Wide) Molded Dual-In-Line Package  
NS Package Number N08E**

N08E (REV F)



**14-Lead (0.300" Wide) Molded Dual-In-Line Package  
NS Package Number N14A**

N14A (REV F)



## Notes

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.

For the most current product information visit us at [www.national.com](http://www.national.com).

### LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

### BANNED SUBSTANCE COMPLIANCE

National Semiconductor certifies that the products and packing materials meet the provisions of the Customer Products Stewardship Specification (CSP-9-111C2) and the Banned Substances and Materials of Interest Specification (CSP-9-111S2) and contain no "Banned Substances" as defined in CSP-9-111S2.



**National Semiconductor**  
**Americas Customer**  
**Support Center**  
Email: [new.feedback@nsc.com](mailto:new.feedback@nsc.com)  
Tel: 1-800-272-9959

[www.national.com](http://www.national.com)

**National Semiconductor**  
**Europe Customer Support Center**  
Fax: +49 (0) 180-530 85 86  
Email: [europa.support@nsc.com](mailto:europa.support@nsc.com)  
Deutsch Tel: +49 (0) 69 9508 6208  
English Tel: +44 (0) 870 24 0 2171  
Français Tel: +33 (0) 1 41 91 8790

**National Semiconductor**  
**Asia Pacific Customer**  
**Support Center**  
Email: [ap.support@nsc.com](mailto:ap.support@nsc.com)

**National Semiconductor**  
**Japan Customer Support Center**  
Fax: 81-3-5639-7507  
Email: [jpn.feedback@nsc.com](mailto:jpn.feedback@nsc.com)  
Tel: 81-3-5639-7560

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Mobile Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Transportation and Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

TI E2E Community Home Page

[e2e.ti.com](http://e2e.ti.com)

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2011, Texas Instruments Incorporated