

# LM112, LM212, LM312 OPERATIONAL AMPLIFIERS/BUFFERS

D3304, AUGUST 1989

- Input Bias Current . . . 3 nA Max Over Full Temperature Range for LM112, LM212
- Input Offset Current . . . 400 pA Max Over Full Temperature Range for LM112, LM212
- Low Noise

## description

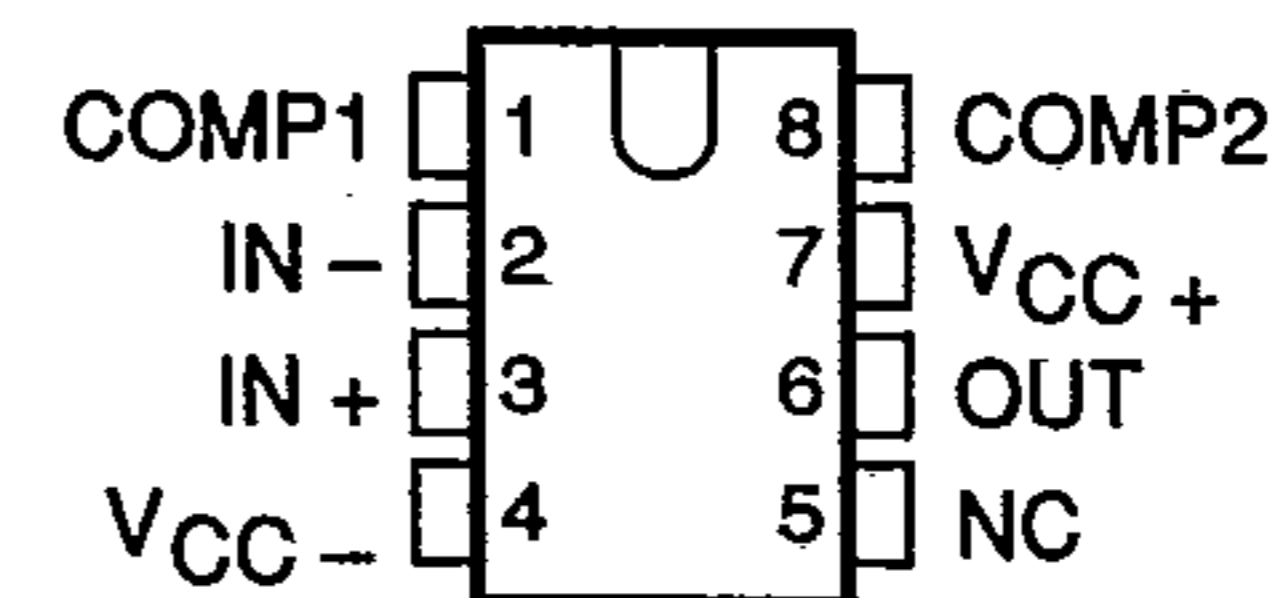
The LM112 series are micropower operational amplifiers with very low input-offset-voltage and input-offset-current errors – at least a factor of ten better than FET amplifiers over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . Similar to the LM108 series, these devices use superbeta transistors. Additionally, they include internal frequency compensation and provide for offset adjustments with a single potentiometer.

These amplifiers will operate on supply voltage of  $\pm 2\text{ V}$  to  $\pm 20\text{ V}$ , drawing a quiescent current of only  $300\ \mu\text{A}$ . Performance is not appreciably affected over this range of voltages, so these devices can be easily operated from unregulated power sources. They can also be operated on a single supply.

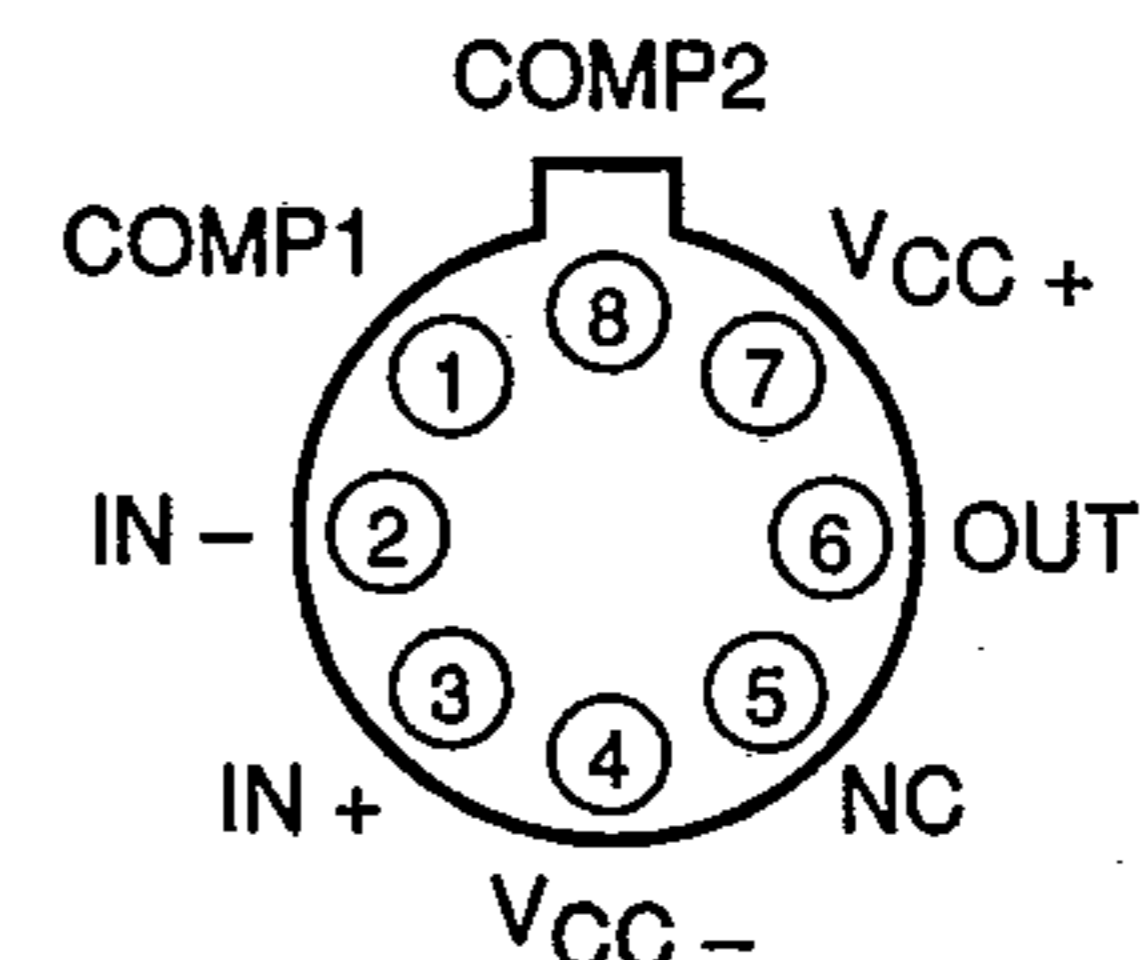
The LM112 series amplifiers include overvoltage protection for the MOS compensation capacitor to prevent failure caused by short-duration overvoltage spikes on the supplies. Unlike other internally-compensated amplifiers, these devices can be overcompensated with an external capacitor to increase the stability margin.

The LM112 is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The LM212 is characterized for operation from  $-40^{\circ}\text{C}$  to  $105^{\circ}\text{C}$ , and the LM312 is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

D, JG, OR P PACKAGE  
(TOP VIEW)

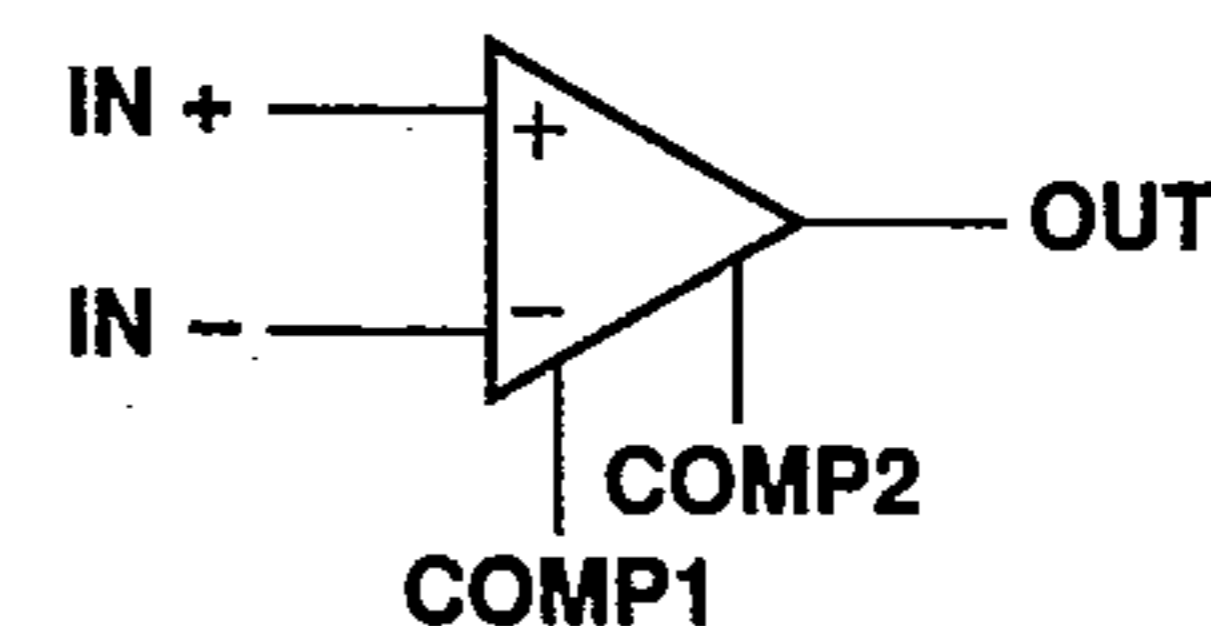


L PACKAGE  
(TOP VIEW)



NC – No internal connection  
Pin 4 of the L package is in electrical contact with the case.

## symbol



## AVAILABLE OPTIONS

T <sub>A</sub>	V <sub>IO</sub> max AT 25°C	PACKAGE			
		SMALL OUTLINE (D)	CERAMIC DIP (JG)	METAL CAN (L)	PLASTIC DIP (P)
0°C to 70°C	7.5 mV	LM312D	LM312JG	LM312L	LM312P
-40°C to 105°C	2 mV	LM212D	LM212JG	LM212L	LM212P
-55°C to 125°C	2 mV	LM112D	LM112JG	LM112L	LM112P

The D package is available taped and reeled. Add the suffix R to the device type (e.g., LM312DR).

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

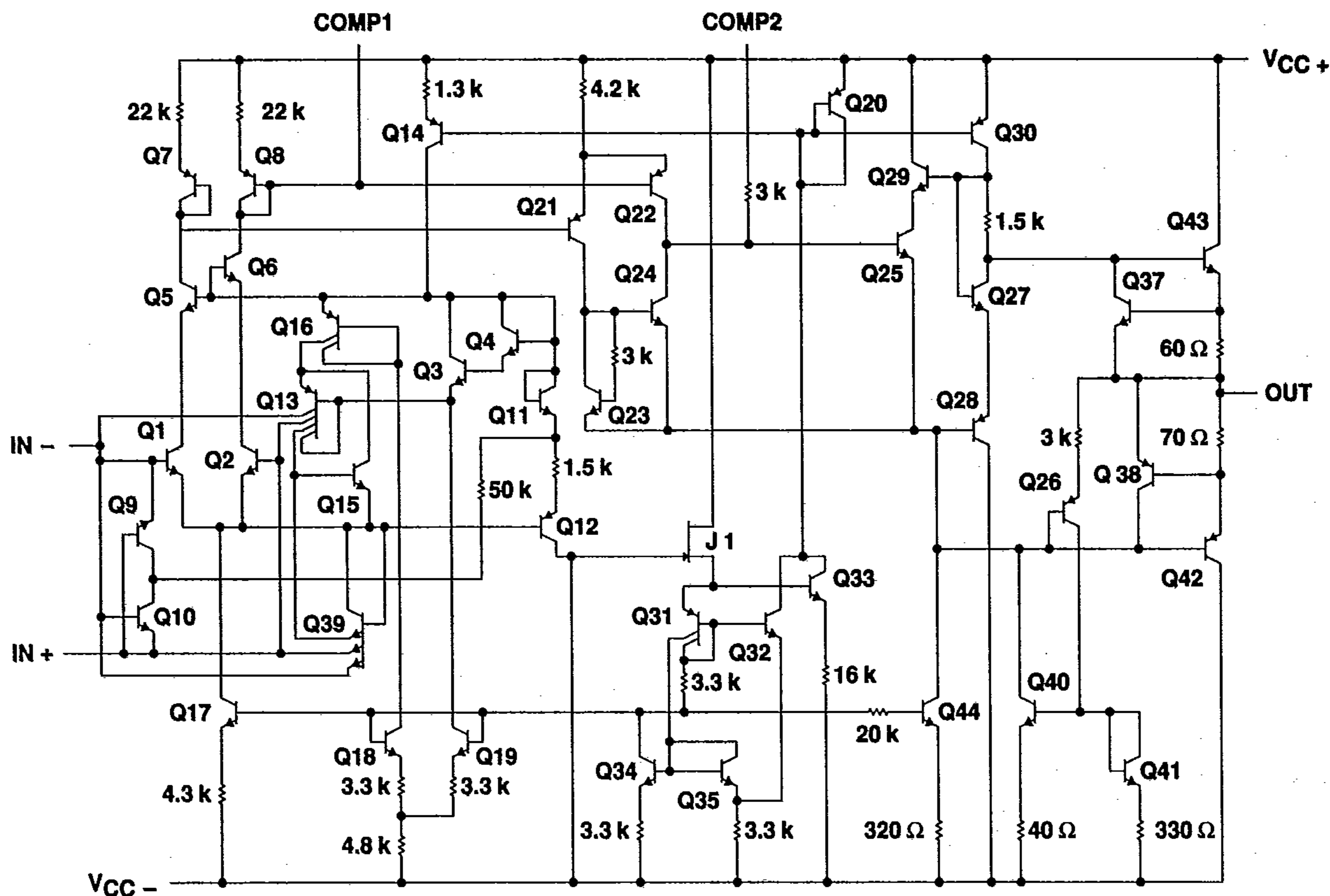
TEXAS  
INSTRUMENTS

Copyright © 1989, Texas Instruments Incorporated

# LM112, LM212, LM312 OPERATIONAL AMPLIFIERS/BUFFERS

TEXAS INSTR (LIN/INTFC)

## schematic



All resistor values shown are nominal and in ohms.

### absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, $V_{CC+}$ (see Note 1): LM112, LM212	20 V
LM312	18 V
Supply voltage, $V_{CC-}$ (see Note 1): LM112, LM212	-20 V
LM312	-18 V
Input voltage range (see Note 2)	$\pm 15$ V
Differential input current (see Note 3)	$\pm 10$ mA
Duration of output short-circuit at (or below) 25°C (see Note 4)	unlimited
Continuous total dissipation	See Dissipation Rating Table
Operating free-air temperature range, $T_A$ : LM112	-55°C to 125°C
LM212	-40°C to 105°C
LM312	0°C to 70°C
Storage temperature range	-65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D or P package	260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG or L package	300°C

- NOTES: 1. All voltage values, except differential voltages, are with respect to the midpoint between  $V_{CC+}$  and  $V_{CC-}$ .
2. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 V, whichever is less.
3. The inputs are shunted with shunt diodes for input overvoltage protection. Therefore, if a differential voltage in excess of 1 V is applied between the inputs, excessive current will flow unless some limiting resistance is used.
4. 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.

# LM112, LM212, LM312 OPERATIONAL AMPLIFIERS/BUFFERS

TEXAS INSTR (LIN/INTFC)

**DISSIPATION RATING TABLE**

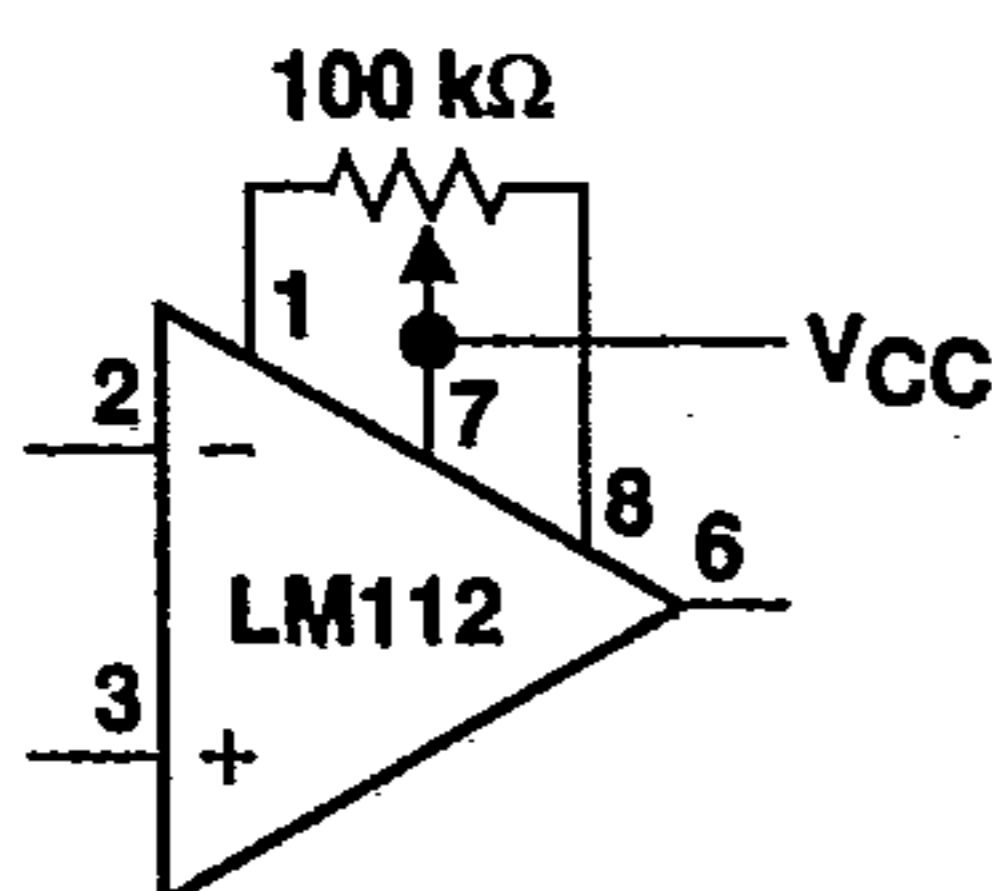
PACKAGE	$T_A \leq 25^\circ\text{C}$	DERATING FACTOR	$T_A = 70^\circ\text{C}$	$T_A = 105^\circ\text{C}$	$T_A = 125^\circ\text{C}$
	POWER RATING	ABOVE $T_A = 25^\circ\text{C}$	POWER RATING	POWER RATING	POWER RATING
D	500 mW	5.8 mW/ $^\circ\text{C}$	464 mW	261 mW	145 mW
JG (LM112)	500 mW	8.4 mW/ $^\circ\text{C}$	500 mW	378 mW	210 mW
JG (LM212, LM312)	500 mW	6.6 mW/ $^\circ\text{C}$	500 mW	297 mW	165 mW
L (LM112)	500 mW	6.6 mW/ $^\circ\text{C}$	500 mW	297 mW	165 mW
L (LM212, LM312)	500 mW	5.2 mW/ $^\circ\text{C}$	416 mW	234 mW	130 mW
P	500 mW	8.0 mW/ $^\circ\text{C}$	500 mW	360 mW	200 mW

electrical characteristics at specified free-air temperature,  $V_{CC\pm} = \pm 5\text{ V}$  to  $\pm 20\text{ V}$  (unless otherwise noted)

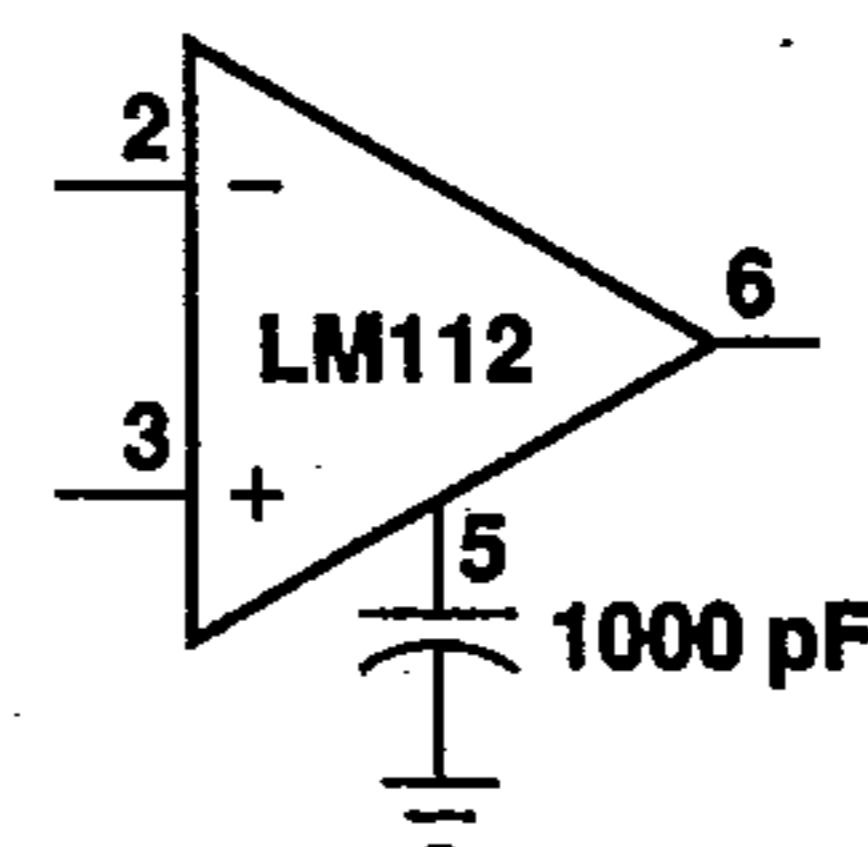
PARAMETER	TEST CONDITIONS	$T_A^\dagger$	LM112, LM212			LM312			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
$V_{IO}$	Input offset voltage	$R_S = 50\ \Omega$	25 $^\circ\text{C}$	0.7	2	2	7.5	mV	
			Full range			3	10		
$\alpha_{VIO}$	Temperature coefficient of input offset voltage	Full range		3	15	6	30	$\mu\text{V}/^\circ\text{C}$	
$I_{IO}$	Input offset current	Full range	25 $^\circ\text{C}$	0.05	0.2	0.2	1	nA	
			Full range			0.4	1.5		
$\alpha_{IIO}$	Temperature coefficient of input offset current	Full range		0.5	2.5	2	10	$\text{pA}/^\circ\text{C}$	
$I_{IB}$	Input bias current	Full range	25 $^\circ\text{C}$	0.8	2	1.5	7	nA	
			Full range			3	10		
$V_{ICR}$	Common-mode input voltage range	$V_{CC\pm} = \pm 15\text{ V}$	Full range	$\pm 13.5$		$\pm 14$		V	
$V_{OM}$	Maximum peak output voltage swing	$V_{CC\pm} = \pm 15\text{ V}$ , $R_L = 10\text{ k}\Omega$	Full range	$\pm 13$		$\pm 13$		V	
$A_{VD}$	Large-signal differential voltage amplification	$V_{CC\pm} = \pm 15\text{ V}$ , $V_O = \pm 10\text{ V}$ , $R_L \geq 10\text{ k}\Omega$	25 $^\circ\text{C}$	50	300	25	300	V/mV	
			Full range	25		15			
$r_i$	Input resistance	25 $^\circ\text{C}$	30	70	10	40	$\text{M}\Omega$		
CMRR	Common-mode rejection ratio	Full range	85		80		dB		
kSVR	Supply-voltage rejection ratio ( $\Delta V_{CC\pm} / \Delta V_{IO}$ )	Full range	80		80		dB		
$I_{CC}$	Supply current	25 $^\circ\text{C}$	0.3	0.6	0.3	0.8	mA		
		105 $^\circ\text{C}$ , 125 $^\circ\text{C}$	0.15	0.4					

$^\dagger$ Full range is  $-55^\circ\text{C}$  to  $125^\circ\text{C}$  for the LM112,  $-40^\circ\text{C}$  to  $105^\circ\text{C}$  for the LM212, and  $0^\circ\text{C}$  to  $70^\circ\text{C}$  for the LM312.

## TYPICAL APPLICATION DATA



**FIGURE 1. OFFSET BALANCING**



**FIGURE 2. OVERCOMPENSATION FOR GREATER STABILITY MARGIN**