

## FEATURES

- *Guaranteed* Max. Offset 5 $\mu$ V
- *Guaranteed* Max. Offset Drift 0.05 $\mu$ V/°C
- Typ. Offset Drift 0.01 $\mu$ V/°C
- Excellent Long Term Stability 100nV/ $\sqrt$ Month
- *Guaranteed* Max. Input Bias Current 30pA
- Over Operating Temperature Range
  - Guaranteed* Min. Gain 120dB
  - Guaranteed* Min. CMRR 120dB
  - Guaranteed* Min. PSRR 120dB
- Single Supply Operation 4.75V to 16V  
(Input Voltage Range Extends to Ground)
- External Capacitors can be Returned to V<sup>-</sup> with No Noise Degradation

## APPLICATIONS

- Thermocouple Amplifiers
- Strain Gauge Amplifiers
- Low Level Signal Processing
- Medical Instrumentation

## DESCRIPTION

The LTC1052 is a low noise chopper-stabilized op amp (CSOA) manufactured using Linear Technology's enhanced LTCMOS™ silicon gate process. Chopper-stabilization constantly corrects offset voltage errors. Both initial offset and changes in the offset due to time, temperature and common-mode voltage are corrected. This, coupled with picoampere input currents, gives this amplifier unmatched performance.

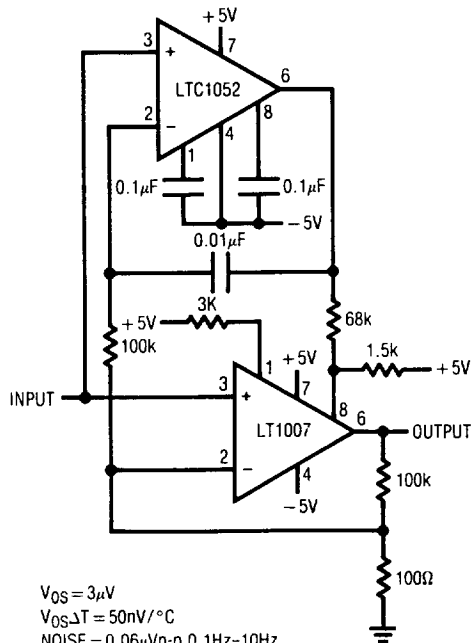
Low frequency (1/f) noise is also improved by the chopping technique. Instead of increasing continuously at a 3dB/octave rate, the internal chopping causes noise to decrease at low frequencies.

The chopper circuitry is entirely internal and completely transparent to the user. Only two external capacitors are required to alternately sample and hold the offset correction voltage and the amplified input signal. Control circuitry is brought out on the 14-pin version to allow the sampling of the LTC1052 to be synchronized with an external frequency source.

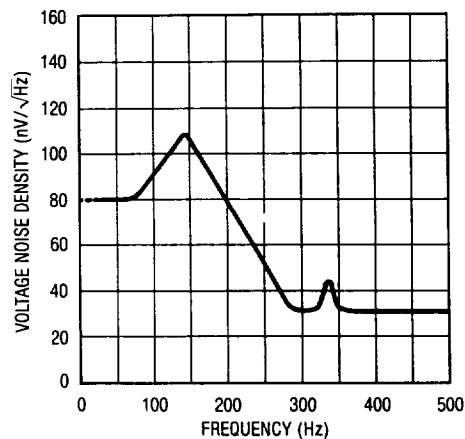
The LTC1052CS is a direct replacement for the ICL7652 in surface mounted packages.

**2**

**Ultra Low Noise, Low Drift Amplifier**



**LTC1052 Noise Spectrum**



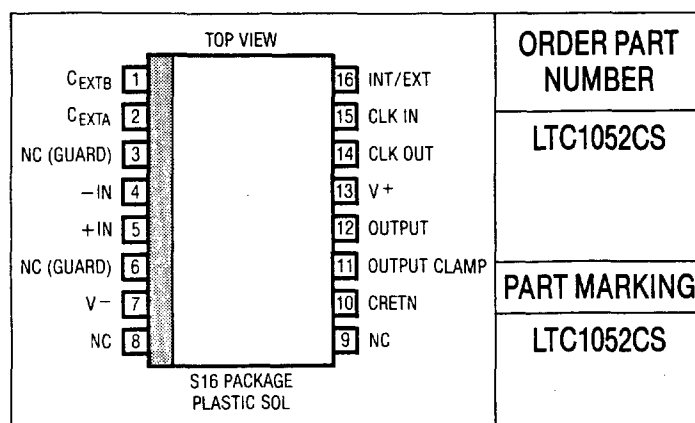
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## ABSOLUTE MAXIMUM RATINGS

(Notes 1 and 2)

Total Supply Voltage ( $V^+$ to $V^-$ ).....	18V
Input Voltage..... ( $V^+ + 0.3V$ ) to ( $V^- - 0.3V$ )	
Output Short Circuit Duration.....	Indefinite
Operating Temperature Range.....	-40°C to 85°C
Storage Temperature Range.....	-65°C to 150°C
Lead Temperature (Soldering, 10 sec.).....	300°C

## PACKAGE/ORDER INFORMATION



## ELECTRICAL CHARACTERISTICS

$V_S = \pm 15V$ ,  $T_A =$  operating temperature range, test circuit TC1 (Note 6), unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	LTC1052C			UNITS
			MIN	TYP	MAX	
$V_{OS}$	Input Offset Voltage	$T_A = 25^\circ C$ (Note 3)		$\pm 0.5$	$\pm 5$	$\mu V$
$\frac{\Delta V_{OS}}{\Delta Temp}$	Average Input Offset Drift	(Note 3)	●	$\pm 0.01$	$\pm 0.05$	$\mu V/^\circ C$
$\frac{\Delta V_{OS}}{\Delta Time}$	Long Term Offset Voltage Stability			100		nV/ $\sqrt{Month}$
$I_{OS}$	Input Offset Current	$T_A = 25^\circ C$	●	$\pm 5$	$\pm 30$ $\pm 350$	pA pA
$I_B$	Input Bias Current	$T_A = 25^\circ C$	●	$\pm 1$	$\pm 30$ $\pm 175$	pA pA
$e_{np-p}$	Input Noise Voltage	$R_S = 100\Omega$ , DC to 10Hz, TC3 (Note 6) $R_S = 100\Omega$ , DC to 1Hz, TC3 (Note 6)		1.5		$\mu Vp-p$ $\mu Vp-p$
$i_n$	Input Noise Current	$f = 10Hz$ (Note 5)		0.6		fA/ $\sqrt{Hz}$
CMRR	Common-Mode Rejection Ratio	$V_{CM} = V^-$ to $+2.7V$	●	120	140	dB
PSRR	Power Supply Rejection Ratio	$V_{SUPPLY} = \pm 2.375V$ to $\pm 8V$	●	120	150	dB
$A_{VOL}$	Large Signal Voltage Gain	$R_L = 10k$ , $V_{OUT} = \pm 4V$	●	120	150	dB
$V_{OUT}$	Maximum Output Voltage Swing (Note 4)	$R_L = 10k$ $R_L = 100k$	●	$\pm 4.7$	$\pm 4.85$ $\pm 4.95$	V V
SR	Slew Rate	$R_L = 10k$ , $C_L = 50pF$		4		V/ $\mu s$
GBW	Gain Bandwidth Product			1.2		MHz
$I_S$	Supply Current	No Load, $T_A = 25^\circ C$	●	1.7	2.0 3.0	mA mA
$f_S$	Internal Sampling Frequency			330		Hz
	Clamp On Current	$R_L = 100k$	●	25	100	$\mu A$
	Clamp Off Current	$-4V < V_{OUT} < +4V$	●	10	100 1	pA nA

The ● denotes specifications which apply over the full operating temperature range.

**Note 1:** Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

**Note 2:** Connecting any terminal to voltages greater than  $V^+$  or less than  $V^-$  may cause destructive latch-up. It is recommended that no sources operating from external supplies be applied prior to power-up of the LTC1052.

**Note 3:** These parameters are guaranteed by design. Thermocouple effects preclude measurement of these voltage levels in high speed automatic

testing.  $V_{OS}$  is measured to a limit determined by test equipment capability. Voltages on  $C_{EXTA}$  and  $C_{EXTB}$ ,  $A_{VOL}$ , CMRR and PSRR are measured to insure proper operation of the nulling loop to insure meeting the  $V_{OS}$  and  $V_{OS}$  drift specifications.

**Note 4:** Output clamp not connected.

**Note 5:** Current noise is calculated from the formula:  $i_n = (2q I_B)^{1/2}$ , where  $q = 1.6 \times 10^{-19}$  coulomb.

**Note 6:** For description of test circuits see LTC1052 standard package data sheet.